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ABSTRACT

This guidebook provides the elements of curriculum that will help educators prepare students for careers in the field of information technology (IT). The introduction addresses national context, skill standards development, and educational response to the skills gap. The high school core IT curriculum is then presented, including: (1) project description; (2) technical learning components (computer trends, database, e-mail, graphics software, hardware installation/configuration, Internet, network technologies, PC principles and operations, presentation software, programming, software installation/configuration, spreadsheet, Windows, and word processing) and foundation learning components (analysis, design/development, documentation and business communication, facilitation/customer service, organization/delivery of presentations, problem solving/troubleshooting, project management, research, self-learning, task management, team work, testing/validation, and workplace skills); (3) learner program outcomes, i.e., statements that support each of the learning components by describing what students must know and be able to do by the end of the program; (4) key competencies and proficiency/expert level performance indicators for each of the learning components; (5) sample activities; and (6) relevant math and science learner program outcomes and key competencies. Appendices include a glossary, a chart of core skill standards, and a resource list. A poster that cross-references the IT high school competencies to Washington State Essential Academic Learning Requirements is also included. (MES)

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Tech Prep Information Technolog Skill Standards-Based Curriculum

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Regional Advanced Technology Education Consortium
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From the moment high school teachers heard about the Information Technology Skill Standards project, the question was: When will it be translated into high school curriculum? Most did not realize that it is ***not*** a simple task to go from skill standards to curriculum. The teachers, staff and administrators that worked on this project worked harder than they expected. They truly deserve our thanks. Our sincere appreciation to the following:

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INTRODUCTION

DEAR EDUCATOR

Welcome to the challenges and excitement of developing skill standards-based curriculum in information technology (IT). The purpose of this guidebook is to provide you with the elements of curriculum that will help prepare your students for careers in the expanding field of information technology.

The need for skilled workers in information technology is enormous. A recent survey by the International Technology Association of America estimated that, due to the lack of skilled workers, there are over 190,000 unfilled information technology jobs right now. This field offers your students opportunities in diverse environments such as banking, software, financial services, manufacturing, etc. IT workers are needed in almost every business and organization. The majority of jobs however, will require some post-secondary education. Getting a strong start in high school will give your students an advantage and that is where you come in: providing a curriculum that will form a strong basis of skills for the new workplace.

There is a place in IT careers for students with a broad range of interests and abilities. The students who are artistic and creative might find their niche as an Interactive Digital Media Specialist while the students with an aptitude for math might find satisfaction as a Programmer Analyst. No matter how different the career fields, all students will require a strong grounding in foundation skills such as critical thinking, communication skills, and teamwork.

The curriculum tools developed in this project have a strong focus on the integration of foundation and technical competencies. This will be evident in the overall learner program outcomes, competencies, and activities. This guidebook contains:

- Core IT skill standards for high school
- Foundation and basic technical competencies appropriate for an IT high school program
- Sample activities
- A cross-reference of the IT high school competencies to Washington State Essential Academic Learning Requirements

Special thanks goes to the thirty teachers who worked diligently for nine months to translate the IT skill standards into a high school curriculum. This guidebook offers the curriculum content, the learner outcomes, and the competencies. It is not yet at the lesson plan level; that is the next phase of our development process. However, we wanted to make this data available for those who want to develop new IT programs, create modules that can be integrated into existing courses, or revise existing IT courses.

We hope the information provided in this guidebook will help in the important work you do in providing excellent opportunities for students. We look forward to hearing from you about how you are using this information.

Sincerely,

Susan Quattrociocchi

Susan Quattrociocchi
Director, Northeast Tech Prep Consortium

Update

As of Summer 1999, the referenced lesson plans are available in the Tech Prep Information Technology Skill Standards-Based Curriculum Modules, Volume 1 (Modules 1-15) and Volume 2 (Modules 16-22). Please reference Ordering Information at the back of this document.

NATIONAL CONTEXT

The continued economic competitiveness of the US depends on closing the qualification gap between the knowledge and skills needed in today's technology-based workplace and the current level of preparation of the workforce. The globalization of wealth and competition together with the development of new technologies has produced a shift to a new economy which is based on the application of information and technology to the development of products and services.

These changes in the global economy have driven the need to redesign organizations to be less hierarchical and more information- and knowledge-based. Organizations are moving from vertical to horizontal divisions of labor with a strong emphasis on teamwork. Their focus has shifted away from narrowly defined job descriptions to broad functions and skills. Foundation knowledge and skills in the workforce have become key ingredients to success. In this changing workplace, workers must think critically, solve problems, communicate effectively, be flexible, and demonstrate a commitment to continuous learning.

In view of the shift to an economy based on knowledge and information and the need for higher levels of skill within the workforce, education is challenged to restructure itself to prepare that new workforce. The majority of jobs created between now and the future will require some post-secondary education, yet more than half of young people leave school without the foundation skills to succeed in post-secondary settings or to secure a good job (*Workforce 2000*).

The intent of this guidebook is to provide high school educators with information to better prepare students for today's workplace.

Michael Maccoby calls the new specialist "technoservice workers." Almost all workers use both technology and interpersonal skills to do their work.

Susan M. Quattrociocchi and Barbara Peterson
Giving Children Hope and Skills for the 21st Century, 1996

SKILL STANDARDS

WHAT ARE SKILL STANDARDS?

Voluntary skill standards establish the agreed-upon, industry-identified knowledge, skills and abilities required to succeed in the workplace. Skill standards are benchmarks of skill and performance attainment that are behavioral and measurable.

Skill standards answer two critical questions:

- What do workers need to know and be able to do to succeed in today's workplace?
- How do we know when workers are performing well?

PYRAMID OF COMPETENCIES

Adapted from *Skill Standards, Qualification Systems, and the American Workforce*

Tier III

Industry-specific technical skills, knowledge, and abilities unique to individual industries or organizations

Examples include:

- Knowledge of and compliance with company practices and organization protocols
- Understanding and effective use of industry terminology
- Knowledge of and compliance with industry legal requirements
- Knowledge of and compliance with company and product standards

Tier II

Technical skills, knowledge, and abilities

Skills common to all jobs within a career cluster across all industries

Examples for IT include:

- Proficient use of software and hardware tools
- Proficient use of Internet techniques
- Understanding of hardware/system architecture
- Troubleshooting of software and hardware problems

Tier I

The set of foundation skills (SCANS), knowledge, abilities, and personal qualities required of all workers to be successful in today's workplace

Foundation skills

- Basic skills (reading, writing, arithmetic…)
- Thinking skills
- Personal qualities

Workplace competencies

- Management of time and resources
- Interpersonal skills
- Management and use of information
- Understanding and management of systems
- Use of technology

WHY SKILL STANDARDS?

There is a lack of any broadly recognized, commonly understood, and agreed-upon articulation of the knowledge, skills, and abilities required to succeed in the workplace.

Joan Willis
Voluntary Skill Standards and Certification Report, 1995

Industrialized nations that have maintained their competitiveness are characterized by a well established skill standards system. Economic competitiveness has caused US government policy makers and educators to reevaluate existing approaches and to develop new strategies for workforce development. Voluntary industry skill standards provide the framework within which US companies can maintain a competitive advantage in the global economy.

Industry skill standards support business and education in the following ways:

- National recognition of skill standards provides a common basis for certifying achievement against those standards, thereby allowing for the portability of skills across companies and careers.
- Industry-identified skill standards serve as a vehicle for companies to communicate their performance expectations to workers, so that workers understand what is expected to perform and advance in their field.
- Voluntary skill standards enable educators to match the curriculum to workplace requirements.
- Skill standards provide workplace expectations so students know what they need to be able to do to meet those expectations.

Skill standards enable business partners to:	Skill standards enable educators to:	Skill standards enable students to:
▪ Match employee skills to work needed. ▪ Assess employee skill levels based on industry standards. ▪ Improve employee satisfaction and morale by clarifying expectations. ▪ Design appropriate training programs and measure their effectiveness. ▪ Improve quality, productivity, time to market and competitiveness.	▪ Provide students with relevant career education. ▪ Develop new and evaluate existing curriculum and programs based on industry needs. ▪ Develop benchmarks for competent student performance. ▪ Collaborate with industry using a common language. ▪ Communicate effectively about education reform to parents and legislators.	▪ Determine business' expectations of the skills needed for career entry. ▪ Enter and reenter the workforce into higher skilled, higher paid jobs. ▪ Improve mobility and portability of their credentials. ▪ Certify the level of competency gained through experience, school or self-study. ▪ Evaluate their skills against those required for career movement and advancement.

THE IT SKILL STANDARDS DEVELOPMENT

In 1996 and 1997, the NorthWest Center for Emerging Technologies (NWCET) and the Regional Advanced Technology Education Consortium (RATEC), in partnership with the Washington Software and Digital Media Alliance (WSDMA) and the Society for Information Management (SIM), identified skill standards in eight information technology career clusters. The project was funded by the National Science Foundation (NSF) and the Washington State Board for Community and Technical Colleges (SBCTC). The skill standards information was published in the 1997 document: *Building a Foundation for Tomorrow: Skill Standards for Information Technology.* (To order, see information at the back of this document.)

The eight IT career clusters are:

- Database Administration Associate
- Information Systems Operator/Analyst
- Interactive Digital Media Specialist
- Network Specialist
- Programmer/Analyst
- Software Engineer
- Technical Support Representative
- Technical Writer

These career clusters were identified in close partnership with industry human resource representatives and managers of IT workers, as career areas of IT that are strongly represented in most industries.

Over 200 IT professionals participated in the development of the IT skill standards. The skill standards information was further validated through a survey mailed to 2,400 companies in Washington State. Companies were equally distributed between high-tech, high-information and low-information companies, and between companies in the Seattle metropolitan area and the rest of the state. The survey results compiled from 940 completed surveys originated from 748 different companies showed that there was no significant difference in what was expected of an IT worker in the different industry segments.

SKILL STANDARDS TO CURRICULUM: A CONTINUOUS DEVELOPMENT PROCESS

Identification of skill standards is only the first step in a continuous process of curriculum and courseware development, articulation among various educational programs and levels, and ongoing feedback and revision to the standards.

Voluntary Industry-Identified Skill Standards

- Research
- Identify career clusters
- Conduct DACUMs* to identify job functions and tasks, and required skills, knowledge, and abilities
- Set performance criteria for tasks
- Create problem-solving scenarios that describe skills, knowledge, and abilities in context
- Validate skill standards
- Disseminate information

Development of Tech Prep IT curriculum

- Identify performance exit benchmarks for Tech Prep IT program
- Identify *IT Tech Prep track* that is competency-based, has exit performance criteria, and is based on the IT skill standards
- Prepare lesson plans for core IT Tech Prep program and selected IT Tech Prep tracks
- Cross-reference IT Tech Prep learner program outcomes with existing standards (for example Washington State Essential Academic Learning Requirements)

Update of the Standards

- Identify emerging career clusters and industry trends
- Revise skill standards as IT industry and careers evolve
- Benchmark skill standards against the skills of high-performance IT professionals

Establishment of Articulation

- Develop model continuous curriculum from high school (Tech Prep) through community and technical college
- Establish articulation agreements based on competencies

**DACUM (Developing A Curriculum):*
A process used to identify the primary functions and tasks within a career cluster.

EDUCATIONAL RESPONSE TO THE SKILLS GAP

CONTINUOUS CURRICULUM

The rapidly changing workplace is especially evident in information technology careers. In a 1996 report, the Information Technology Association of America documented a conservative estimate of 190,000 unfilled positions in information technology. The challenge of high schools, colleges and universities is to provide an adequate number of students with the appropriate skills to meet this demand. Achievement of this goal depends on the development of a continuous curriculum, an articulated 2+2+2 curricular structure spanning high school, community and technical colleges and four-year college and university degrees.

INTEGRATED CURRICULUM

Skill standards-based curriculum helps communicate the needs of the workplace. To be successful in that workplace, workers need to be involved in continual learning and develop skills that are portable across jobs and career fields.

The skills gap described by employers of IT workers is most often depicted as the lack of foundation skills; e.g., critical thinking, communication skills, problem solving, etc. Current and relevant technical skills are seen by employers as being essential to success in IT, however, maintaining technical skills is seen as more easily addressed than foundation skills if there are gaps. Developing foundation skills in such areas as team membership, project management, flexibility, and effective decision making are a much greater challenge. It has been said that good technical skills will get you a job in IT but ongoing success is dependent on good foundation skills.

The greatest implication for educators of skill standards-based curriculum is the greater emphasis on foundation skills in the professional/technical programs. The successful completion of every function and task in the workplace requires the use of foundation skills to apply technology to solve ever-changing problems.

The key to the development of curriculum informed by industry skill standards, therefore is integration and context. This means the explicit identification and sequencing of both the technical knowledge and foundation skills appropriate for a particular program. They are both then integrated into learning activities that allow for the development of foundation skills within the context of solving real problems. The student sees the context for learning foundation skills as well as the technical knowledge; being an effective team member, problem solver, and self learner has a purpose, context and connection that provides motivation for holistic learning.

The advantages of skill standards-based integrated curriculum are:

- Curriculum is based on industry expectations for success.
- Curriculum that is competency-based and outcomes-based makes it easier to identify benchmarks for appropriate education levels and facilitates articulation.
- A more explicit focus on foundation skills allows for greater accountability for learners, and certification and portability of foundation skills.
- A competency-based and outcomes approach that is based on clear industry standards provides a model that is contextualized, and it provides activities that infuse the technical content with foundation skills.
- It reinforces the importance of work-based learning and experiences.
- Authentic assessments reflect the infusion of technical and process content.
- It breaks down the traditional barriers between disciplines; especially academic and technical and allows for more authentic integration of content, and concepts.

Technology of itself doesn't create anything. It's simply a tool and it's no more inspired than Rembrandt's brush.

Stewart McBride
President, United Digital Artists

COMPETENCY-BASED CURRICULUM

WHY COMPETENCY-BASED EDUCATION (CBE)?

Industry-identified skill standards provide a consistent, broadly accepted set of expectations required to be successful in today's workplace; they describe what employees must know and be able to do. It is the role of educators to translate the industry standards into appropriate curricular responses.

This means that the corresponding curriculum must also be a form of standards-based learning which emphasizes what learners know and can do as a result of the outcomes of the learning process.

The skill standards provide the framework for the curriculum; they are not the curriculum. Educators must provide the translation from the task structure of skill standards into learning components and outcomes.

WHAT IS CBE?

Competency-based education and training is an organized set of learning experiences that are:

- based on competencies (knowledge, skills, attributes) to be demonstrated by the learner.
- derived from occupational expectations.
- explicit in stating expected mastery levels.

Essential elements of CBE:

Competencies (knowledge, skills, and behavior) to be demonstrated by the learner.
These are:

- derived from explicit conceptions of the occupational role;
- stated so as to make possible assessment of a learner's behavior in relation to specific competencies;
- made public in advance.

Criteria to be employed in assessing competencies. These are:

- based upon, and in harmony with, specified competencies;
- explicit in stating expected levels of mastery under specified conditions;
- made public in advance.

Assessment of the student's competencies. That:

- use performance as the primary source of evidence;
- take into account evidence of the learner's knowledge; relevant to planning for, analyzing, interpreting, or evaluating situations or behaviors;
- strive for objectivity.

The learner's rate of progress through the program is determined by demonstrated competency rather than time or course completion.

The instructional program is intended to facilitate the development and evaluation of the learner's achievement of specified competencies.

This information has been excerpted from *Competency-Based Education and Training*, Robert Harris, High Guthrie, Barry Hobart and David Lundberg. 1995, MacMillan Educ.

Science and technology multiply around us. They dictate the languages in which we speak and think. Either we use those languages, or we remain mute.

J. G. Ballard, English Novelist

MATH AND SCIENCE

Skill standards are framed in the language of the workplace. Because few IT managers or professionals consider their primary tasks as scientific or mathematical, they seldom associate science and math with the skills necessary to be successful. Yet many of the competencies the jobs require are those that are learned through science and mathematics education, such as analysis, problem solving, logical reasoning and interpretation of evidence. Therefore, the primary justification for science and math in IT curriculum is implicit rather than explicit. The infusion of appropriate science and math curriculum in information technology is essentiál to develop these desired fundamental thinking skills.

TECH PREP

Tech Prep is another educational response to address the skills gap. Tech Prep is a planned sequence of study which begins in high school and continues to the post-secondary level. The program is designed to ensure that students have the opportunity to continue their education (without duplication or repetition) based on a continuum of knowledge, skills and attitudes learned in their high school Tech Prep programs.

Tech Prep integrates academic and technical subjects within an identified competency-based, technical curriculum. Students who are able to demonstrate their skill/competence receive community/technical college credit from their selected participating community/technical colleges.

Because mathematics and science provide a set of unique procedures, such as hypothesis testing, that promote further learning, it appears that a grasp of the procedures involved in applying mathematical and scientific principles can also be viewed as basic skills.

O*NET
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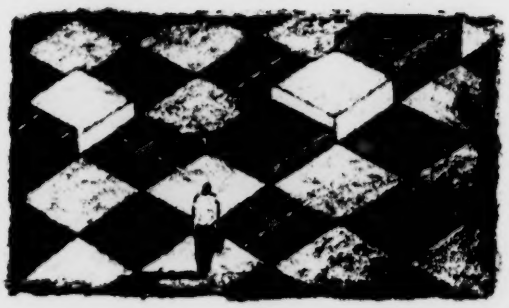


HIGH SCHOOL CORE INFORMATION TECHNOLOGY CURRICULUM

THIS PROJECT

PROJECT GOALS

This project was a joint partnership of the NWCET, NE Tech Prep Consortium, RATEC, and the Seattle School District. Funding was provided by the National Science Foundation and the NE Tech Prep Consortium.

Thirty teachers representing seven school districts, three community colleges, and one four-year college worked together for ten months to generate the results represented in this document. The disciplines represented by this team of teachers includes: math, science, technology, and humanities.

The purpose of this project was to identify the major elements of a skill standards-based, Tech Prep IT curriculum.

The goals for this project were to:

- Develop a core IT Skill Standards for high school
- Develop foundation and basic technical competencies appropriate for an IT high school program
- Cross-reference the IT Tech Prep competencies to existing academic standards

GUIDING PRINCIPLES

The information presented in this guidebook is based on the following guiding principles:

- Based on the Information Technology Skill Standards
- Competency-based
- Outcomes-oriented (describing what learners should know and be able to do)
- Modular and flexible, allowing adaptability within a variety of program contexts
- Infused with appropriate math and science (including both specific content and "essential thinking")
- Deliberate and sequential in addressing both technical knowledge and foundation skills
- Integrated technical knowledge and foundation skills through learner activities
- Linked with appropriate performance-based assessment systems including alternative approaches such as portfolios, progressive projects, and simulations
- Inclusive of work-based experiences and learning
- Integrated in spirit and practice

PURPOSE OF THIS DOCUMENT

This document provides a description of what high school students need to know and be able to do in order to pursue careers in information technology (IT). The information represents the primary framework and curriculum elements for a skill standards-based high school IT curriculum.

Students can use this information to:

- Learn what industry expects of today's workers in IT careers
- Learn what they need to know and be able to do to successfully perform in college level IT courses
- Determine areas of strength and areas needing improvement
- Identify a portfolio of skills that can be transferred to other institutions and curriculum tracks

Teachers can use this information to:

- Learn what industry expects of today's workers in IT careers
- Build or revise a specialized high school IT track
- Develop IT modules that can be integrated into existing courses
- Infuse IT competencies in an existing high school academic curriculum
- Assess student progress and achievements against benchmarks
- Articulate high school programs with college programs

Counselors can use this information to:

- Learn what industry expects of today's workers in IT careers
- Assist students in planning their educational programs and careers opportunities
- Help students prepare job-search materials using industry language
- Assist students in identifying emerging career fields and occupations

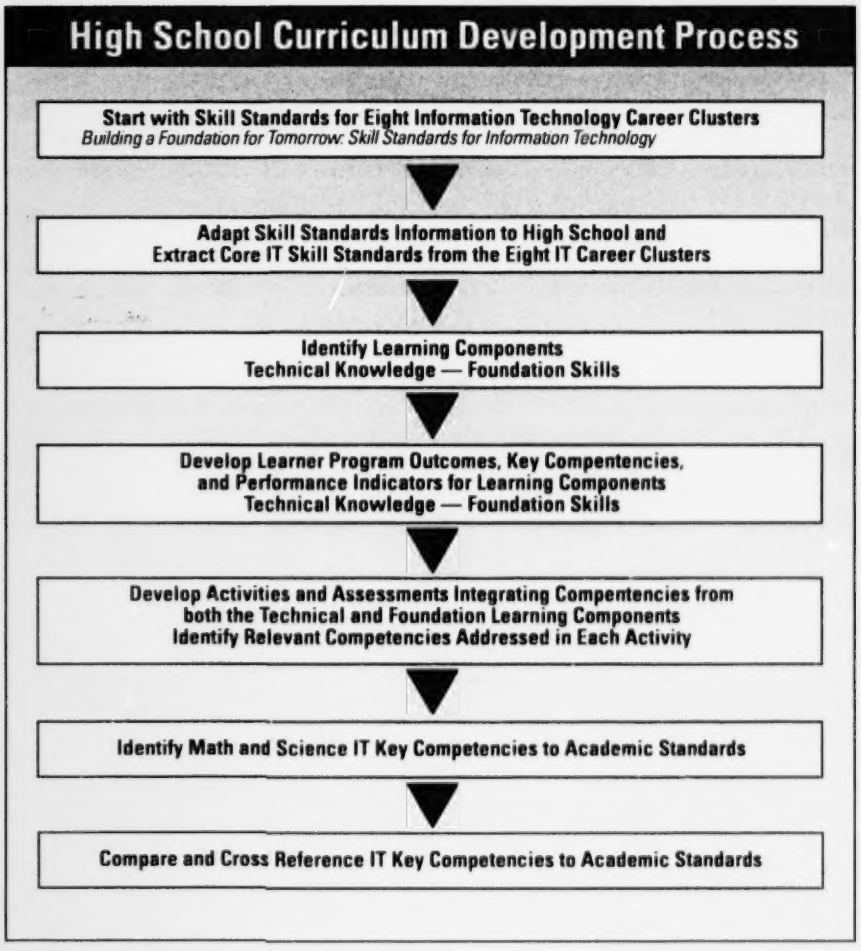
HIGH SCHOOL CURRICULUM DEVELOPMENT PROCESS

Adapt Skill Standards Information to High School and Extract Core IT Skill Standards from the Eight IT Career Clusters

Starting from the industry IT skill standards identified by the NWCET for eight IT career clusters (published in *Building a Foundation for Tomorrow: Skill Standards for Information Technology),* a core of IT skill standards adapted to high school was developed by the teachers involved in this project.

The first step was to select and modify those functions and tasks appropriate for the high school level. During this process, no functions were dropped, but some tasks were dropped, combined, or edited.

The next step, was to extract the core IT skill standards from this adapted information. Functions and tasks that were common to all career clusters were selected. In some cases some functions or tasks were common to all clusters but had different names or descriptions. The descriptions were then combined under a common label (e.g., Research). Even though Research, as a function, is not included in all eight career cluster skill standards, elements of research are present in each of them. In other cases, some functions and tasks (e.g., Facilitation/Customer Service), were kept even though they did not appear in every cluster, because they were deemed essential to an IT core program.


High School Curriculum Development Process
Start with Skill Standards for Eight Information Technology Career Clusters
Building a Foundation for Tomorrow: Skill Standards for Information Technology
Adapt Skill Standards Information to High School and Extract Core IT Skill Standards from the Eight IT Career Clusters
Identify Learning Components
Technical Knowledge — Foundation Skills
Develop Learner Program Outcomes, Key Compentencies, and Performance Indicators for Learning Components
Technical Knowledge — Foundation Skills
Develop Activities and Assessments Integrating Compentencies from both the Technical and Foundation Learning Components
Identify Relevant Competencies Addressed in Each Activity
Identify Math and Science IT Key Competencies to Academic Standards
Compare and Cross Reference IT Key Competencies to Academic Standards

After the core functions and tasks were selected, the performance criteria were defined using the original IT skill standards information as a guide, and adapting that information to high school. Finally, relevant technical knowledge and foundation skills were selected for each task. The end result was core IT skill standards adapted for high school.

See Appendix for core IT high school skill standards.

Identify Learning Components
Technical knowledge ■ Foundation skills

The Learning Components are the main areas of related or associated content or skills that are best taught/learned together and represent logical pieces of curricula.

From the core IT Tech Prep Skill standards, twenty-seven Learning Components similar in size and scope were defined. Learning Components were organized in two groups:

- Technical Learning Components in which technical knowledge is the primary focus
- Foundation Learning Components in which foundation skills or basic skills are the primary focus.

As an example, the Learning Component: **Business Knowledge** requires the students to learn and understand business concepts and terminology, classifying this component as primarily a Technical Learning Component. On the other hand, the Learning Component: **Problem Solving/ Troubleshooting** requires the students to master creative thinking, reasoning and communication processes, classifying this component as primarily a Foundation Learning Component.

Note that no Learning Component is purely a Technical Learning Component or a Foundation Learning Component. All Learning Components include elements of technical knowledge and elements of foundation or basic skills. This distinction however, helps to give equal emphasis to technical knowledge and foundation or basic skills. Too often, technical knowledge is given priority over mastery of foundation skills. Industry managers caution that mastery of technical knowledge will get a worker hired, but it is the mastery of foundation skills that will make that worker highly valued in the organization.

For purpose of context, the Learning Components are listed in the next section.

Develop Learner Program Outcomes, Key Competencies, and Performance Indicators for Learning Components
Technical knowledge ■ Foundation skills

Learner Program Outcomes are statements that support each of the Learning Components. They describe what students must know and be able to do by the end of the program. Key Competencies are required to achieve the Learner Program Outcomes. Key Competencies are specific, observable behaviors, knowledge, abilities, and skills. Performance Indicators may be used to assess student attainment of skill and knowledge. The Performance Indicators are divided into two levels of mastery: proficiency and expert.

One to four Learner Program Outcomes were defined for each Learning Component. An example of a Learner Program Outcome in the Documentation and Business Communication Learning Component is for the student to:

- Demonstrate the ability to create and present accurate and effective communication (oral and written) tailored to the specific purpose and needs of the audience.

For each Learning Component, ten to fifteen Key Competencies and ten to twenty Performance Indicators were identified to further specify the Learner Program Outcomes. Examples of Key Competencies and associated Performance Indicators for the Learner Program Outcome given above are:

- Key Competency: Be responsive to audience and adjust communication style accordingly.
- Performance Indicator - Proficiency Level: Use appropriate language, style and format based on the needs of the project and audience.
- Performance Indicator - Expert Level: Accurately synthesize content with audience by determining level of understanding of audience.

The Learner Program Outcomes, and the Key Competencies and Performance Indicators for each of the Learning Components are included in the following sections.

Develop Activities and Assessments Integrating Competencies from both the Technical and Foundation Learning Components

Identify Relevant Competencies Addressed in each Activity

Sample activities and assessments were developed for each Learning Component. This report provides three sample activities. For each activity relevant competencies were identified. The remainder of the activities and the assessments generated during this project will be further developed and refined to serve as the basis for the development of actual lesson plans. They will be available in the subsequent publication of lesson plans and classroom tools.

Sample activities are included in the following section.

Emphasis was placed on integrating competencies from the technical learning components with competencies from foundation learning components.

The primary development of foundation skills should occur within the context of solving real-world problems. Therefore, this model integrates the technical knowledge and foundation skills through activities in the teaching/learning process. The student sees the context for learning foundation skills as well as the technical knowledge; being an effective team member, problem solver and/or self-learner has a purpose, context and connection that provides motivation for holistic learning. In the work environment competencies from various areas are used together and, therefore, should be learned in an integrated manner whenever possible rather than in isolation.

Identify Math and Science Outcomes and Competencies

DACUM panels were assembled from IT professionals with at least an undergraduate major in math or a natural science. The results of these panels were compared with the recommendations of college faculty in science, math and information technology and reviewed by the IT industry advisory committees of existing well-regarded 2-year IT degree programs. The consensus derived from these inputs was compared with high school science and math standards developed by other organizations. A set of existing math and science standards were adapted and included as an example.

Compare and Cross Reference IT Key Competencies to Academic Standards

The IT Learner Program Outcomes represent the core IT competencies that should be addressed at the high school level. IT competencies may be cross-referenced to the other academic standards. As an example, a crosswalk between the IT Tech Prep core Learner Program Outcomes and the Washington State Essential Academic Learning Requirements is provided in poster form.

You may order additional posters. For more information, see the ordering information at the end of this document.

LEARNING COMPONENTS

The Learning Components are the main areas of related or associated content or skills that are best taught/learned together and represent logical pieces of curricula.

From the core IT Tech Prep Skill Standards, twenty-seven Learning Components similar in size and scope were defined. Learning Components were organized in two groups:

- **Technical Learning Components,** in which technical knowledge is the primary focus
- **Foundation Learning Components,** in which foundation skills or basic skills are the primary focus

LEARNING COMPONENTS FOR CORE IT TECH PREP CURRICULUM

Technical Learning Components

- Computer Trends in Business and Society
- Database
- E-mail
- Graphics Software
- Hardware Installation/Configuration
- Internet
- Network Technologies
- PC Principles and Operations
- Presentation Software
- Programming
- Software Installation/Configuration
- Spreadsheet
- Windows
- Word Processing

Foundation Learning Components

- Analysis
- Design/Development
- Documentation and Business Communication
- Facilitation/Customer Service
- Organization/Delivery of Presentations
- Problem Solving/Troubleshooting
- Project Management
- Research
- Self-Learning
- Task Management
- Team Work
- Testing/Validation
- Workplace Skills

LEARNER PROGRAM OUTCOMES

Learner Program Outcomes are statements that support each of the Learning Components by describing what students must know and be able to do by the end of the program.

LEARNER PROGRAM OUTCOMES

Computer Trends in Business and Society

Technical Learning Component

- Demonstrate an understanding of how IT impacts the operation and management of business and society.
- Demonstrate an understanding of past and current trends in computer technology.

Database

Technical Learning Component

- Demonstrate the ability to design, create, modify and use relational databases, including developing queries, forms and reports.
- Demonstrate the ability to apply databases to actual situations and business problems.

E-mail

Technical Learning Component

- Demonstrate a basic understanding of e-mail system components and organization.
- Demonstrate the ability to use e-mail effectively and appropriately.
- Demonstrate an ability to use basic e-mail functions and tools.

Graphics Software

Technical Learning Component

- Demonstrate a knowledge of available graphics software applications.
- Demonstrate the ability to apply basic principles of visual communication in transferring data into graphics form.
- Demonstrate the ability to create simple graphics documents using drawing and painting software programs.

Hardware Installation/Configuration

Technical Learning Component

- Demonstrate knowledge of individual parts that make up a stand-alone PC computer system, and the relationships between components.
- Demonstrate the ability to install and configure hardware in a PC computer system.
- Demonstrate basic knowledge of PC hardware troubleshooting and maintenance.

Internet

Technical Learning Component

- Demonstrate the ability to use the Internet as a research tool in a highly efficient manner.
- Demonstrate the ability to create and maintain Web pages.

Network Technologies

Technical Learning Component

- Demonstrate an understanding of the overall design and components of a LAN and WAN system.
- Demonstrate the ability to perform basic setup and configuration of network hardware and software.
- Demonstrate the ability to monitor overall network operations, troubleshoot basic problems, and implement administrative functions.

PC Principles and Operations

Technical Learning Component

- Demonstrate knowledge and understanding of the primary PC components.
- Demonstrate the ability to perform basic personal computer operations.
- Demonstrate an understanding of the issues affecting system purchase and upgrade decisions.

Presentation Software

Technical Learning Component

- Demonstrate the ability to use the components of presentation software creatively and effectively.
- Demonstrate proficiency in using presentation software functions.

Programming

Technical Learning Component

- Demonstrate an understanding of programming concepts and basic programming principles.
- Demonstrate the ability to apply programming structures and languages to develop simple programs.

Software Installation/Configuration

Technical Learning Component

- Demonstrate the ability to install software programs and perform basic configuration operations.
- Demonstrate a basic understanding of compatibility issues.
- Demonstrate the ability to troubleshoot basic configuration problems.

Spreadsheet

Technical Learning Component

- Demonstrate the ability to design, create, modify, and troubleshoot spreadsheets.
- Demonstrate the ability to create graphs and charts.
- Demonstrate the ability to apply spreadsheet principles to real-life situations and to solve business problems.

Windows

Technical Learning Component

- Demonstrate the ability to perform basic operations and troubleshoot basic problems in a Windows environment.
- Demonstrate the ability to customize the operating system environment.
- Demonstrate the ability to run multiple applications at the same time, and import and export data between applications.

Word Processing

Technical Learning Component

- Demonstrate proficiency in keyboarding skills.
- Demonstrate basic word processing skills, such as document formatting, editing and using tables.
- Demonstrate the ability to create simple word processing documents such as letters, memos and basic reports.
- Demonstrate the ability to create compound documents, such as newsletters, with graphics and objects from multiple software applications.

Analysis

Foundation Learning Component

- Demonstrate the ability to gather data to identify requirements, and to interpret and evaluate the requirements.
- Demonstrate the ability to analyze the process interactively to continuously improve the outcome.
- Demonstrate the ability to understand constraints, generate alternatives, consider risks, and evaluate options.

Design/Development

Foundation Learning Component

- Demonstrate the ability to apply the design and development process from beginning to end (start to finished "deliverable").
- Demonstrate the ability to evaluate and assess the effectiveness of the design and development process.

Documentation and Business Communication

Foundation Learning Component

- Demonstrate an understanding of the purpose and process of communication (oral and written) in organizations.
- Demonstrate the ability to create and present accurate and effective communication (oral and written) tailored to the specific purpose and needs of the audience.

Facilitation/Customer Service

Foundation Learning Component

- Demonstrate personal qualities, attitudes and key skills that foster successful relationships with customers.

Organization/Delivery of Presentations

Foundation Learning Component

- Demonstrate the ability to select presentation technology, methods and material appropriate to the audience and the purpose of the presentation.
- Demonstrate the ability to prepare a learning environment appropriate to the purpose and audience.
- Demonstrate the ability to organize and deliver the presentation material.
- Demonstrate the ability to assess the effectiveness of the presentation, and make recommendations for process and content improvements.

Problem Solving/Troubleshooting

Foundation Learning Component

- Demonstrate the ability to identify and use a wide range of resources and techniques to identify technical problems, and develop and implement resolution plans.
- Demonstrate the ability to identify and use appropriate communication tools and methods to correctly isolate and identify technical problems.

Project Management

Foundation Learning Component

- Demonstrate an understanding of the basic phases of project management, and the ability to use appropriate project management planning tools and methods.
- Demonstrate the ability to coordinate the use of resources with other team members and groups.

Research

Foundation Learning Component

- Demonstrate the ability to identify and use traditional and non-traditional sources of information.
- Demonstrate the ability to apply effectively and choose appropriately from a variety of research methods and tools.
- Demonstrate the ability to analyze, organize and present research material.

Self-Learning

Foundation Learning Component

- Demonstrate the ability to identify a self-learning path and plan experiences to meet learning goals.
- Demonstrate a knowledge of various learning styles and an understanding of one's own learning style.
- Demonstrate the ability to identify and use sources of training appropriate to meet the specific training needs.
- Demonstrate the ability to apply new learning, and to evaluate new learning in the context of learning goals.

Task Management

Foundation Learning Component

- Demonstrate the ability to organize and prioritize multiple tasks in the most effective way.
- Demonstrate the ability to allocate time and resources according to task complexity and priority.
- Demonstrate the ability to evaluate task outcomes and continuously improve process.

Team Work

Foundation Learning Component

- Demonstrate the ability to organize and work in a team setting.
- Demonstrate the ability to recognize expertise and to learn from others, and demonstrate collaborative decision making.
- Demonstrate the ability to work and communicate effectively with persons of different backgrounds.

Testing/Validation

Foundation Learning Component

- Demonstrate an understanding of the fundamental principles of testing methodology.
- Demonstrate the ability to effectively apply a wide range of testing methods and tools.
- Demonstrate the ability to choose the testing methods and tools most appropriate for the scope and purpose of project.
- Demonstrate the ability to interpret test results, and communicate results and consequences.

Workplace Skills

Foundation Learning Component

- Demonstrate the ability to work successfully in the workplace.
- Demonstrate leadership skills, where applicable, and show flexibility in accepting others' leadership.
- Demonstrate the ability to accept responsibility for one's own behavior and be aware of its impact on others.

KEY COMPETENCIES AND PERFORMANCE INDICATORS

- **Learner Program Outcomes**
- **Key Competencies**
- **Performance Indicators: Proficiency Level**
- **Performance Indicators: Expert Level**

Learner Program Outcomes are statements that support each of the Learning Components by describing what students must know and be able to do by the end of the program.

Two additional levels of detail support the Learner Program Outcomes

- **Key Competencies**
- **Performance Indicators**

Key Competencies and Performance Indicators are specific, observable behaviors, knowledge, abilities, and skills. Performance Indicators may be used to assess student attainment of skill and knowledge competencies.

The Performance Indicators are divided into two levels of mastery:

- **Proficiency**
- **Expert**

TECHNICAL LEARNING COMPONENTS

COMPUTER TRENDS IN BUSINESS AND SOCIETY

TECHNICAL LEARNING COMPONENT

Learner Program Outcomes

- Demonstrate an understanding of how IT impacts the operation and management of business and society.
- Demonstrate an understanding of past and current trends in computer technology.

Key Competencies

Demonstrate the ability to:

- Describe how both PC's and larger computer systems are used in the business community.
- Present an overview of the career opportunities using computers in business.
- Present the positive and negative impacts of computer technology on business and society.
- Discuss ethical issues in respect to the information age.
- Discuss issues related to information privacy and security risks.
- Discuss trends affecting computers and the information processing industry.
- Describe how business information systems are likely to change in the future.
- Summarize the evolution of the computer industry.
- Discuss environmental concerns related to computers.

Performance Indicators – Proficiency level

Demonstrate the ability to:

- Write a description of the main categories of computer systems.
- Describes how computer systems are used in different parts of a business organization.
- Describe the career opportunities available in the information processing industry.
- Present the main areas that provide the majority of computer-related jobs.
- Describe how computers have eliminated and created jobs.
- Describe the psychological and health risks associated with computers.
- Describe security risks and their associated safeguards.
- Describe the impact of computers on access to information and information exchange worldwide.
- Present ethical issues as they relate to the use of computers and information in today's society.
- Define information privacy and describe how it has been and is currently affected by computers.
- Present major milestones in the history of computers and their impact on society.
- Describe how the increased use of computer systems impacts the environment.

Performance Indicators – Expert level

Demonstrate ability to:

- Develop recommendations for ethical codes of conduct for computer usage.
- Describe how business needs for information have impacted technological development and society.
- Describe how information systems will change in the following areas: equipment, software, data, users, information systems, personnel, privacy and ethics.

DATABASE
TECHNICAL LEARNING COMPONENT

Learner Program Outcomes

- Demonstrate the ability to design, create, modify and use relational databases, including developing queries, forms and reports.
- Demonstrate the ability to apply databases to actual situations and business problems.

Key Competencies

Demonstrate the ability to:

- Design, create and use relational databases.
- Create and edit tables.
- Develop and modify queries.
- Use search and sort features.
- Use queries to analyze data.
- Design and modify forms.
- Create and format reports.
- Import information from other applications.
- Design databases to meet the needs of specific applications and users.

Performance Indicators – Proficiency level

Demonstrate the ability to:

- Design simple databases.
- Open a database, create tables, and modify table design.
- Add, delete, and modify records.
- Search a table to locate specific records.
- Sort data in a single field.
- Enter data using a form.
- Create and modify a simple form.
- Create and modify simple queries.
- Create, modify and customize reports.
- Switch between views.
- Print a form, report, and results of a query.
- Apply databases to simple problems.

Performance Indicators – Expert level

Demonstrate ability to:

- Design a database that solves a business problem or applies to a real-life situation.
- Explain relationship between database components.
- Sort data on multiple fields.
- Add and remove filters.
- Create queries with multiple criteria.
- Create and apply the different types of query.
- Join tables in a query.
- Enhance the design of a form.
- Identify the need for and create sub forms.
- Group data in reports.
- Make a calculation on a report.
- Imbed, import, and link data (including graphics).

E-MAIL

TECHNICAL LEARNING COMPONENT

Learner Program Outcomes

- Demonstrate a basic understanding of e-mail system components and organization.
- Demonstrate the ability to use e-mail effectively and appropriately.
- Demonstrate an ability to use basic e-mail functions and tools.

Key Competencies

Demonstrate the ability to:

- Explain the purpose and basic features of e-mail systems.
- Describe and explain the purpose of e-mail features and options.
- Send, receive, reply, forward, save, delete messages.
- Use the login and password system.
- Print messages, documents and files.
- Attach documents to messages.
- Create distribution lists.
- Develop a folder for saved messages and documents, and organize messages.
- Access e-mail system support help facilities and e-mail tools.
- Explain and use appropriate e-mail etiquette.
- Explain security issues and the purpose of guidelines for legal usage of e-mail.
- Use e-mail appropriately according to organization guidelines.
- Use e-mail options such as "reply requested" and "out-of-office reply".
- Explain the issues of virus contamination through e-mail, and discuss protection strategies.

Performance Indicators – Proficiency level

Demonstrate the ability to:

- Send, receive, reply, forward, save, delete messages.
- Be proficient in the use of login and password systems.
- Create short, simple, concise messages.
- Print messages, documents, files.
- Create, send and save attachments.
- Create, save and use distribution lists.
- Use external e mail addresses.
- Explain and use priority levels on messages.
- Explain and use successfully appropriate e-mail etiquette.
- Explain and actively follow guidelines for legal usage.
- Create folders and organize messages.

Performance Indicators – Expert level

Demonstrate ability to:

- Explain the role of e-mail as an integral part of the organization communication system.
- Recognize data integrity and security issues which affect e-mail usage.
- Explain and develop appropriate guidelines for e-mail etiquette and legal usage.
- Participate on an e-mail management team.
- Train new e-mail users.
- Use advanced e-mail tools and options.
- Discuss virus protection strategies when receiving e-mail messages.

GRAPHICS SOFTWARE
TECHNICAL LEARNING COMPONENT

Learner Program Outcomes

- Demonstrate a knowledge of available graphics software applications.
- Demonstrate the ability to apply basic principles of visual communication in transferring data into graphics form.
- Demonstrate the ability to create simple graphics documents using drawing and painting software programs.

Key Competencies

Demonstrate the ability to:

- Identify and explain key differences between different types of graphics software.
- Use graphics tools, menus, and functions, such as grouping, transformations and blending.
- Use simple and advanced development tools, styles, templates, and wizards.
- Use simple and advanced techniques to manipulate object attributes and types.
- Use 2-dimensional and 3-dimensional graphics principles.
- Import and export objects to and from other applications.
- Create graphics which integrate principles of communication and elements of visual design.
- Select the appropriate style of graphics based on the intended purpose.
- Choose and use the most effective graphics application software for the intended project.

Performance Indicators – Proficiency level

Demonstrate the ability to:

- Explain the main features and purposes of graphics software.
- Develop, edit, save, retrieve graphical information.
- Effectively use templates, wizards, and modeling tools.
- Edit 2-dimensional objects and attributes.
- Effect 2-dimensional transformations.
- Apply 2-dimensional special effects.
- Use graphics tools and functions.
- Import and export objects from and to other applications.
- Work with and incorporate graphics from on-line resources.
- Describe and compare different styles of graphic representations.

Performance Indicators – Expert level

Demonstrate ability to:

- Teach others and self to develop, edit, save, retrieve graphical information.
- Edit 3-dimensional objects and attributes.
- Effect 3-dimensional transformations.
- Apply 3-dimensional special effects.
- Explain the differences between main graphics applications.
- Create graphics which communicate the intended message and appeal to the target audience.
- Analyze the effectiveness of graphics in communicating the message, and make recommendations for improvement.

HARDWARE INSTALLATION/ CONFIGURATION

TECHNICAL LEARNING COMPONENT

Learner Program Outcomes

- Demonstrate knowledge of individual parts that make up a stand-alone PC computer system, and the relationships between components.
- Demonstrate the ability to install and configure hardware in a PC computer system.
- Demonstrate basic knowledge of PC hardware troubleshooting and maintenance.

Key Competencies

Demonstrate the ability to:

- List and describe functions of the primary PC components.
- Explain how hardware components interact and how conflicts arise.
- Install, upgrade and configure hardware.
- Install and configure peripherals.
- Use appropriate safety precautions when working with PCs.
- Collect and analyze system information.
- Identify preventative maintenance procedures.
- Identify and address various error messages and symptoms of hardware failures.

Performance Indicators – Proficiency level

Demonstrate the ability to:

- Diagram, label and describe the functions of the components inside the system unit.
- Diagram, label and describe the features of the motherboard and its key components.
- Assemble and disassemble PCs.
- Explain the subsystems within the PC and how they interact.
- Describe and document the boot process.
- Describe how conflicts arise between components in a PC.
- Install RAM.
- Describe and demonstrate the use of safety precautions when working with PCs.
- Install and configure peripheral devices such as mice and printers.
- Access and configure the CMOS set up.
- Use available resources to determine a PCs component information such as size of hard drive, amount of RAM, and type of processor.
- Perform routine preventative maintenance for hardware.

Performance Indicators – Expert level

Demonstrate the ability to:

- Install and configure components such as modems, CD-ROM drives and hard disks.
- Perform advanced preventative maintenance for hard disks using utilities software.
- Research and document solutions to error messages or symptoms of a hardware problem.

INTERNET
TECHNICAL LEARNING COMPONENT

Learner Program Outcomes

- Demonstrate the ability to use the Internet as a research tool in a highly efficient manner.
- Demonstrate the ability to create and maintain Web pages.

Key Competencies

Demonstrate the ability to:

- Use browser including: starting the browser, moving between Web pages, saving Web addresses, saving and editing text and images to hard drive or floppy disk, using search engines.
- Make appropriate, responsible, ethical choices of what information (content and level) to pursue, use, and distribute, depending on context and target user.
- Present different search engines specific strengths, weaknesses and special features.
- Use Boolean logic to conduct effective searches.
- Locate and download software upgrades from the Internet.
- Create Web pages including internal and external links, and using Web page development tools and appropriate programming languages.

Performance Indicators - Proficiency level

Demonstrate the ability to:

- Use the main functions of Internet browsers.
- Move between Web pages using addresses and links.
- Save and edit text and images from Web pages.
- Use basic search engines and explain search results.
- Refine searches to obtain more specific information.
- Produce a list of appropriate Internet addresses for a specific research topic.
- Teach other students/teachers how to use browsers on the Internet.
- Present the features, advantages and disadvantages of different browsers.
- Choose the best search engine for a specific research assignment, and justify choice.
- Use Boolean functions in search engines.
- Produce a Web page with at least 5 links to other pages.
- Use appropriate reference material and help in solving browser problems.
- Use and distribute Internet information within the guidelines of the organization.

Performance Indicators - Expert level

Demonstrate the ability to:

- Learn to use commands and strategies of new browsers as they become available.
- Produce an interactive Web page including animation, live video, and/or sound.
- Collect interactive data, Web page of forms and/or frames for a research presentation.
- Download software upgrades from the Internet.
- Explain the purpose of plug-ins.
- Discuss ethical issues around use and distribution of information through the Internet, and propose guidelines within a specific organizational context.

NETWORK TECHNOLOGIES
TECHNICAL LEARNING COMPONENT

Learner Program Outcomes

- Demonstrate an understanding of the overall design and components of a LAN and WAN system.
- Demonstrate the ability to perform basic setup and configuration of network hardware and software.
- Demonstrate the ability to monitor overall network operations, troubleshoot basic problems, and implement administrative functions.

Key Competencies

Demonstrate the ability to:

- Explain networking concepts and principles.
- Present and explain the design and features of LAN & WAN systems.
- Install and configure a network server.
- Setup and configure a basic workstation connected to the network.
- Setup and configure network components such as network interface cards, printers, and CD-ROM devices.
- Construct network cables and test network connectivity using a network analyzer.
- Determine the type of network topology needed, such as peer-to-peer and server based.
- Explain the type of wiring needed for the physical connection of the network.
- Setup and manage user accounts, groups, and file security for the system.
- Setup and configure TCP/IP services on workstations and network servers.
- Perform basic troubleshooting activities at the workstation and server level.
- Implement a basic security system, backup procedures and maintenance.

Performance Indicators - Proficiency level

Demonstrate the ability to:

- Explain networking concepts and different network structures.
- Install a network server.
- Configure a network server.
- Determine hardware requirements for a network operating system.
- Determine hardware requirements for a workstation operating system.
- Connect and configure workstation to the LAN.
- Install and configure network cards.
- Connect and share network printers and CD-ROM devices to the network.
- Input and manage user accounts and groups.
- Document a LAN topology.
- Perform and document basic troubleshooting activities at the workstation and physical levels (i.e. wiring, circuit).
- Perform a standard tape backup.
- Perform regular maintenance procedures of network system.
- Recognize the advantages and disadvantages of peer-to-peer network operating systems.

NETWORK TECHNOLOGIES
TECHNICAL LEARNING COMPONENT
(CONTINUED)

Performance Indicators - Expert level

Demonstrate the ability to:

- Install and configure TCP/IP protocol on workstations and servers.
- Design and document network maintenance procedures.
- Implement and manage a network security system.
- Connect and configure LAN networks into a WAN.
- Troubleshoot and maintain WAN connectivity.
- Setup and configure bridges and routers for network connectivity.
- Troubleshoot and maintain the network servers.

PC PRINCIPLES AND OPERATIONS

TECHNICAL LEARNING COMPONENT

Learner Program Outcomes

- Demonstrate knowledge and understanding of the primary PC components.
- Demonstrate the ability to perform basic personal computer operations.
- Demonstrate an understanding of the issues affecting system purchase and upgrade decisions.

Key Competencies

Demonstrate the ability to:

- Explain the differences between hardware and software.
- Present the purpose of different software applications and their purpose.
- Explain the principal PC components and their use.
- Explain the difference between operating systems, programs and files.
- Start up and shut down systems.
- Manage and organize files.
- Identify, launch and exit programs.
- Use the mouse and keyboard, and other peripherals.
- Evaluate computing needs and recommend an appropriate computer system for a specific application and context.
- Explain tradeoffs between purchasing a new system and upgrading an existing system.

Performance Indicators - Proficiency Level

Demonstrate the ability to:

- Explain the differences between hardware and software.
- Choose the appropriate software to complete a given task.
- Explain the difference between systems software and applications software.
- Diagram, label and describe the function of the PC components.
- Format a disk and create folders to organize data.
- Copy, rename, delete and move files.
- Create, save, modify and print files.
- Create, rename and delete folders.
- Turn on and off systems using correct procedure.
- Compare and contrast main memory with auxiliary storage.
- Use printers and other peripherals.

Performance Indicators - Expert Level

Demonstrate the ability to:

- Hook up and plug in a computer system and its peripherals.
- Explain how a computer represents and processes data.
- Explain the appropriate decision making process when purchasing a personal computer system.
- Explain the issues in buying/upgrading a computer system.
- Given a certain business environment, make recommendations for system upgrade or purchase.

PRESENTATION SOFTWARE

TECHNICAL LEARNING COMPONENT

Learner Program Outcomes

- Demonstrate the ability to use the components of presentation software creatively and effectively.
- Demonstrate proficiency in using presentation software functions.

Key Competencies

Demonstrate the ability to:

- Explain the features and functions of a presentation software package.
- Create presentation slides and handouts.
- Use the different templates and slide backgrounds.
- Use and modify the slide master.
- Apply different formats on a slide.
- Sort and organize slides.
- Use slide transitions and build effects.
- Apply the principles and fundamentals of graphics design in creating slides.
- Import graphics, spreadsheets and charts.
- Create effective presentations communicating clearly the topic.
- Create interesting presentations appealing to the target audience.

Performance Indicators - Proficiency level

Demonstrate the ability to:

- Create and save a slide presentation.
- Create, edit, and move an object.
- Format text and layout.
- Format slide color and background.
- Show the slide show.
- Use slide transitions and build effects.
- Choose from a list slide layouts and use accordingly.
- Insert clipart and graphics.
- Organize the presentation in a logical sequence.
- Create slides that are easy to read.
- Choose effective fonts and layouts.

Performance Indicators - Expert level

Demonstrate the ability to:

- Create or import charts and graphs.
- Use outline feature to move text and slides.
- Use master slide to create new slides and notes.
- Apply and edit slide templates.
- Import graphics, spreasheets and charts.
- Teach another student to use the presentation software.
- Adapt a slide presentation based on the purpose of the presentation and the audience.
- Analyze the effectiveness of the design of a presentation and make recommendations for improvement.

PROGRAMMING
TECHNICAL LEARNING COMPONENT

Learner Program Outcomes

- Demonstrate an understanding of programming concepts and basic programming principles.
- Demonstrate the ability to apply programming structures and languages to develop simple programs.

Key Competencies

Demonstrate the ability to:

- Explain the purpose and functions of computer programs, and program components.
- Explain the term programming language and present examples for each of the various categories of programming languages.
- Discuss the factors that should be considered when choosing a programming language.
- Describe and apply the five steps of program development.
- Recognize and describe the steps in a program life cycle.
- Explain and apply the design concepts and tools used in structured programming.
- Explain, illustrate and apply the sequence selection and iteration control structures used in structured programming.
- Explain the levels, differences and appropriate use of programming styles including event-driven, object oriented and traditional procedural programming.
- Use internal and external program documentation.
- Explain and apply the process of logical organization of data.
- Design, write, test and troubleshoot simple programs.

PROGRAMMING
TECHNICAL LEARNING COMPONENT (CONTINUED)

Performance Indicators – Proficiency level

Demonstrate the ability to:

- Explain the purpose and functions of computer programs.
- Define the components of a computer program.
- Present and compare various programming languages.
- Select a programming language for a given task and explain selection.
- Explain the differences in programming styles.
- Explain the steps in a program life cycle.
- Use the five steps of program development: problem definition and requirements, alternate solutions, design, development, implementation and testing.
- Use structured programming design processes including organized approach, top-down approach, modular design, structured walk-throughs and ego-less programming.
- Use printer spacing and screen layout charts, record layout charts, structured or HIPO charts, Warnier-Orr diagrams, algorithms, pseudo-code, structured English, Nassi-Schneiderman bar charts and flow charts.
- Explain and correctly apply the order of operation in computation.
- Explain and apply debugging processes including software debugging utilities.
- Explain and apply testing procedures including appropriate data testing processes to check all logic structures and conditions.
- Use the control structure to solve a problem.
- Apply the While/Do versus Do Until at the appropriate time.
- Design a program for a specific application.
- Create the components of a computer program.
- Test and debug the program.
- Document the program.

Performance Indicators – Expert level

Demonstrate ability to:

- Develop a complete program using the five steps of development from the original problem statement/request.
- Work directly with the user throughout the program development process.
- Participate in a development team using the structured work-throughs and ego-less programming techniques.
- Incorporate the development tools to support the complete development process and ongoing program documentation.
- Develop a complete testing process including test data for a computer program.

SOFTWARE INSTALLATION/ CONFIGURATION

TECHNICAL LEARNING COMPONENT

Learner Program Outcomes

- Demonstrate the ability to install software programs and perform basic configuration operations.
- Demonstrate a basic understanding of compatibility issues.
- Demonstrate the ability to troubleshoot basic configuration problems.

Key Competencies

Demonstrate the ability to:

- Analyze and inventory hardware and software to determine compatibility.
- Choose between default and custom installation options.
- Configure software to appropriate operating system settings.
- Troubleshoot unexpected results and formulate a new installation procedure.
- Document step by step installation and configuration procedures.
- Disable currently installed software that may interfere with installation of new software.
- Research and obtain help from manufacturers' technical help lines.
- Identify differences between an upgrade and new installation, and proceed accordingly.
- Identify differences between stand-alone and network installation procedures.
- Install application and system software on a variety of platforms.

Performance Indicators – Proficiency level

Demonstrate the ability to:

- Document complete hardware specifications required for successful software installation.
- Document complete software specifications including operating systems and currently installed programs.
- Install software using default options.
- Document steps involved in a software installation procedure.
- Perform simple configuration of software after installation.
- Disable software that may interfere with installation of new software.
- Use help lines to troubleshoot when appropriate.
- Install new software on standalone computers.
- Install software in DOS and a variety of Windows type environments.
- Read and follow documentation that accompanies software products.

Performance Indicators – Expert level

Demonstrate ability to:

- Install software using customized options.
- Solve unexpected installation problems and develop alternative procedures.
- Modify software configuration to meet user needs and preferences.
- Install new software on network computers.
- Install upgrades on network computers.
- Develop an installation plan.

SPREADSHEET
TECHNICAL LEARNING COMPONENT

Learner Program Outcomes

- Demonstrate the ability to design, create, modify, and troubleshoot spreadsheets.
- Demonstrate the ability to create graphs and charts.
- Demonstrate the ability to apply spreadsheet principles to real-life situations and to solve business problems.

Key Competencies

Demonstrate the ability to:

- Explain and apply spreadsheet design principles.
- Develop, edit, save, retrieve, and print spreadsheets.
- Format spreadsheets.
- Use simple and advanced formulas.
- Create graphs and charts from spreadsheets.
- Troubleshoot spreadsheets and resolve errors.
- Import and export data and objects to/from other applications.
- Use advanced spreadsheet functions.
- Apply spreadsheet principles to business decision making.
- Apply spreadsheet principles to real-life situations.

Performance Indicators - Proficiency level

Demonstrate the ability to:

- Design spreadsheets.
- Develop, edit, and save spreadsheets.
- Locate and retrieve spreadsheets.
- Print spreadsheets using print options.
- Create graphs and charts from spreadsheets.
- Use simple spreadsheet formulas.
- Format spreadsheets.
- Troubleshoot simple problems.
- Create simple spreadsheets for personal applications.
- Use online help to learn about features and correct problems.

Performance Indicators - Expert level

Demonstrate the ability to:

- Embed spreadsheets in other applications.
- Import data and embed objects in a spreadsheet.
- Use advanced spreadsheet formulas.
- Interpret and resolve error messages.
- Troubleshoot spreadsheets.
- Create and use macros.
- Link several spreadsheets.
- Make what/if business decisions using spreadsheets as a tool.
- Design and implement complex forecasting spreadsheets for personal use.

WINDOWS

TECHNICAL LEARNING COMPONENT

Learner Program Outcomes

- Demonstrate the ability to perform basic operations and troubleshoot basic problems in a Windows environment.
- Demonstrate the ability to customize the operating system environment.
- Demonstrate the ability to run multiple applications at the same time, and import and export data between applications.

Key Competencies

Demonstrate the ability to:

- Coordinate mouse and keyboard operations, including: point and click, drag and drop, shift-click, and substitute keyboard strokes for mouse.
- Manage files in a Windows environment.
- Open and close files and applications in a Windows environment.
- Customize the desktop environment.
- Use Windows accessories.
- Use help to troubleshoot problems.
- Run MS-DOS-based programs from Windows.
- Move between files and applications, and transfer data between applications.

Performance Indicators – Proficiency level

Demonstrate the ability to:

- Use the mouse to point, click, double click, drag and scroll.
- Browse through files and locate specific files.
- Create folders, and organize files on disks and in folders.
- Move, copy, rename and delete files and folders.
- Back up files.
- Format floppy disks.
- Start programs and open document files.
- Set date and time.
- Customize display such as screen savers and wall paper.
- Use desktop accessories.
- Use help to learn about a specific procedure.
- Run MS-DOS programs from Windows.
- Switch between different files within the same application.
- Switch between different applications.

Performance Indicators – Expert level

Demonstrate ability to:

- Transfer data between applications.
- Create shortcuts on desktop.
- Customize environment using the control panel.
- Add commands to the start menu.
- Add programs to the program menu.
- Manage hard drive using system tools.
- Switch to a different printer on the network.
- Substitute keyboard strokes for mouse.
- Use dial-up networking.
- Identify problems and conduct basic troubleshooting procedures.
- Describe the purpose of different types of files and recognize a file type through its extension.

WORD PROCESSING
TECHNICAL LEARNING COMPONENT

Learner Program Outcomes

- Demonstrate proficiency in keyboarding skills.
- Demonstrate basic word processing skills, such as document formatting, editing and using tables.
- Demonstrate the ability to create simple word processing documents such as letters, memos and basic reports.
- Demonstrate the ability to create compound documents, such as newsletters, with graphics and objects from multiple software applications.

Key Competencies

Demonstrate the ability to:

- Keyboard at a minimum speed of 35 wpm with 90% accuracy.
- Create, edit, save, retrieve, and print documents.
- Use simple formatting functions.
- Use print previews and print options.
- Use search and replace, navigation keys and functions.
- Work with document styles, forms and templates.
- Use word-processing utility tools including spell checker, thesaurus and grammar checker.
- Work with columns and tables.
- Work with outlines, footnotes, and endnotes.
- Work with graphics and charts.
- Use advanced formatting functions, including text flow options, watermarks, different first page options, and alternating footers and headers.
- Create business documents in standard formats and styles.
- Embed objects from other applications and Internet sources.

Performance Indicators - Proficiency level

Demonstrate the ability to:

- Keyboard at a minimum speed of 35wpm with 90% accuracy.
- Create, save and print documents.
- Locate and open existing documents.
- Create, edit, delete and move text.
- Format text and paragraphs.
- Use the tab setting functions.
- Create bulleted items and change bullet format.
- Format a page, including setting margins, page numbers, headers and footers.
- Use styles, forms and templates.
- Use find and replace functions and options.
- Use navigation keys and functions.
- Format and print envelopes and labels.
- Use utility tools, including spell checker, thesaurus, and grammar checker.
- Create, format, modify, delete, and move columns.
- Create, format and edit tables.
- Use print preview and print options.
- Use help screens.

WORD PROCESSING
TECHNICAL LEARNING COMPONENT (CONTINUED)

Performance Indicators - Expert level

Demonstrate the ability to:

- Create and modify an outline.
- Create and revise footnotes and endnotes.
- Use advanced formatting options, including text flow options, watermarks, different first page options, and alternating footers and headers.
- Import or create, and modify imbedded objects.
- Create and use macros.
- Create a mail merge.
- Create and modify lines and objects.
- Create style sheets and templates.
- Create different types of business documents in standard formats and styles, including standard memos, reports, letters and newsletters.

FOUNDATION LEARNING COMPONENTS

ANALYSIS
FOUNDATION LEARNING COMPONENT

Learner Program Outcomes

- Demonstrate the ability to gather data to identify requirements, and to interpret and evaluate the requirements.
- Demonstrate the ability to analyze the process interactively to continuously improve the outcome.
- Demonstrate the ability to understand constraints, generate alternatives, consider risks, and evaluate options.

Key Competencies

Demonstrate the ability to:

- Identify focus and general parameters of task or project.
- Gather data to identify project requirements or problem, resources and risks.
- Evaluate requirements and identify missing or conflicting information.
- Analyze and synthesize information and make recommendations.
- Identify time, technology and resource constraints, in general terms.
- Develop risk analysis and demonstrate flexibility in adopting alternative strategies.
- Prepare a cost/benefit estimate for the project or task.
- Establish measurable performance requirements and test strategies.
- Determine whether further analysis is necessary and support recommendations.
- Develop feedback strategies to monitor and improve the overall process of analysis.
- Communicate and document information and the recommendations.

ANALYSIS
FOUNDATION LEARNING COMPONENT (CONTINUED)

Performance Indicators – Proficiency level

Demonstrate the ability to:

- Identify relevant sources of information and recognize the customers for the project or task.
- Gather data and extract relevant information.
- Analyze and synthesize the information.
- Identify missing information and find sources to complete requirement set.
- Identify conflicting information and resolve conflicts with customers, if necessary.
- Validate information for accuracy and completeness.
- Develop an outline of the task or project constraints.
- Ask questions to clarify application and procedure.
- Develop measurable performance requirements.
- Recommend test strategies that meet needs and resources.
- Summarize, communicate and document information.

Performance Indicators – Expert level

Demonstrate ability to:

- Develop an outline of potential risks.
- Present alternative strategies and make recommendations.
- Determine need for further analysis and make recommendations.
- Prepare a cost/benefit analysis of the project.
- Make recommendations based on the analysis.
- Develop a cost/benefit estimate of different possible strategies.
- Develop feedback strategies to monitor the process of analysis.
- Evaluate the process of analysis and its effectiveness, and make recommendations for improvement.

DESIGN/DEVELOPMENT
FOUNDATION LEARNING COMPONENT

Learner Program Outcomes

- Demonstrate the ability to apply the design and development process from beginning to end (start to finished "deliverable").
- Demonstrate the ability to evaluate and assess the effectiveness of the design and development process.

Key Competencies

Demonstrate the ability to:

- Identify the phases and objectives of the systems development life cycle.
- Explain the advantages and disadvantages of developing your own information system versus purchasing or leasing from a vendor.
- Define and evaluate a variety of analysis and design tools appropriate to the project.
- Use a variety of analysis and design tools, such as data flow diagrams and prototyping.
- Explain the importance of project documentation during the design/development process.
- Perform the necessary steps in the design/development process.
- Evaluate effectiveness of design/development tools and processes, and make recommendations for improvement.
- Compare prototype with design requirements and make recommendations.

Performance Indicators – Proficiency level

Demonstrate the ability to:

- Describe the phases in the systems development life cycle.
- Discuss each of the steps of evaluating and acquiring commercial systems.
- Describe the reasons for developing custom software and hardware.
- Describe how prototyping is used in the systems development life cycle.
- Explain the purpose of documentation during the design/development phase.
- Develop and evaluate design alternatives.
- Propose, design and test solutions.
- Document solutions, design and testing processes, and test results.
- Perform post-implementation evaluation.

Performance Indicators – Expert level

Demonstrate ability to:

- Develop test specifications for a given system.
- Design and build a system that meets an end user's needs.
- Define the contents of the systems design specification document and explain its purpose.
- Explain the higher levels of testing.
- Compare the delivered system to the requested system and determine whether the new system meets the specified requirements.
- Evaluate the system documentation for accuracy, completeness and timeliness of information.
- Develop a trade-off analysis and recommendations for in-house development versus outside lease/purchase for a given system within a specific organizational context.
- Evaluate effectiveness of the design/development tools and processes and make recommendations for improvement.
- Make recommendations for system maintenance based on design parameters.

DOCUMENTATION AND BUSINESS COMMUNICATION

FOUNDATION LEARNING COMPONENT

Learner Program Outcomes

- Demonstrate an understanding of the purpose and process of communication (oral and written) in organizations.
- Demonstrate the ability to create and present accurate and effective communication (oral and written) tailored to the specific purpose and needs of the audience.

Key Competencies

Demonstrate the ability to:

- Present the different forms of communication and their respective purpose in the organization.
- Evaluate and effectively use various communication techniques and formats.
- Organize communication in a logical sequence, and support communication with necessary data.
- Use clear, focused, specific and grammatically correct language and terminology.
- Display attitudes that foster effective communication.
- Communicate effectively with audiences with various degrees of expertise in a wide range of technical contexts.
- Be responsive to audience and adjust communication style accordingly.

Performance Indicators – Proficiency level

Demonstrate the ability to:

- Explain the role of communication in organizations.
- Present the different styles of communication used in an organization.
- Communicate clearly and concisely to the appropriate audience.
- Be courteous and professional when communicating with others.
- Use effective listening and paraphrasing skills.
- Use appropriate language, style and format based on the needs of the project and audience.
- Use proper grammar and appropriate style and level of terminology sophistication.
- Translate technical jargon and concepts into everyday English.
- Use a variety of research materials to support the communication process.
- Analyze/interpret and summarize/synthesize information.
- Analyze and summarize group/individual responses.
- Organize concept and ideas into a logical outline.
- Produce multiple drafts that demonstrate knowledge of proofreading.
- Work with a team to peer edit.
- Correctly format letters, memos and reports.

Performance Indicators – Expert level

Demonstrate ability to:

- Use graphics and audio-visual media to support the communication process when appropriate.
- Accurately synthesize content with audience by determining level of understanding of audience.
- Explain the different styles of communication used in formal and informal communication processes.
- Explain how different audiences demand different levels of communication/ presentation.
- Mediate conflicting ideas and perspectives, and use effective negotiation skills.

FACILITATION/CUSTOMER SERVICE

FOUNDATION LEARNING COMPONENT

Learner Program Outcomes

- Demonstrate personal qualities, attitudes and key skills that foster successful relationships with customers.

Key Competencies

Demonstrate the ability to:

- Explain the importance of customer service in organizations.
- Identify and exhibit the qualities and attitudes that foster successful relationships with customers.
- Formulate a proactive plan/strategy that is efficient in satisfying customer needs, and in creating and keeping customers
- Negotiate/communicate solutions to the customer and follow-up with appropriate testing or check-up strategies.
- Interpret and define the customer's needs and communicate information to relevant groups of the organization.

Performance Indicators – Proficiency level

Demonstrate the ability to:

- Explain the role of customer service in an organization.
- Use market research analysis to develop a plan for providing excellent customer service.
- Use proactive attitudes to develop excellent customer service.
- Contribute ideas to develop an effective training program for excellent customer service.
- Recognize and meet customer needs to feel welcome, to be understood, to feel comfortable, to feel important.
- Maintain effective customer communication.
- Recognize a customer complaint as positive feedback.
- Resolve customer complaints fairly and promptly.
- Maintain positive self-management under pressure.
- Use telephone courtesy incorporating techniques for active listening.
- Communicate customer feedback to relevant groups and members of the organization.

Performance Indicators – Expert level

Demonstrate ability to:

- Gather and analyze market research and customer feedback for customer service.
- Develop recommendations for effective strategies for excellent customer service.
- Develop and implement an effective training program for excellent customer service.
- Keep oneself energized, motivated and positive.
- Recognize unacceptable behaviors in customer service.
- Recognize the primary reasons for customer complaints.
- Say "No" without arousing resentment.
- Explain the steps to be taken to repair damaged customer relationships.
- Develop a proactive self-stress plan.

ORGANIZATION/ DELIVERY OF PRESENTATIONS

FOUNDATION LEARNING COMPONENT

Learner Program Outcomes

- Demonstrate the ability to select presentation technology, methods and material appropriate to the audience and the purpose of the presentation.
- Demonstrate the ability to prepare a learning environment appropriate to the purpose and audience.
- Demonstrate the ability to organize and deliver the presentation material.
- Demonstrate the ability to assess the effectiveness of the presentation, and make recommendations for process and content improvements.

Key Competencies

Demonstrate the ability to:

- Identify available technology and materials to support the presentation.
- Select a technology delivery system and method appropriate to the size and nature of the audience and purpose of the presentation.
- Identify the requirements relating to the presentation space and environment.
- Organize the presentation so that the material is complete, logically sequenced and meets presentation timelines.
- Deliver the presentation using good speaking skills and appropriate technology to enhance the delivery of the content.
- Obtain and use feedback to assess the overall effectiveness of the presentation.

Performance Indicators – Proficiency level

Demonstrate the ability to:

- List technology delivery systems and methods available to aid presentation.
- Describe the strengths and weaknesses of different presentation technologies.
- Estimate the size and skill level of the audience to determine the scope of the material to be presented.
- Identify the space requirements for the technology (i.e., power, lighting) used for the delivery.
- Estimate the time requirements for each segment of the presentation.
- Organize the material by outlining the presentation in a logical sequence.
- Employ good presentation skills and use technology in a supplemental/enhancing role.
- Identify various means of obtaining feedback.
- Use feedback to identify areas for improvement in the presentation.

Performance Indicators – Expert level

Demonstrate ability to:

- Research alternate presentation technologies and methods.
- Develops original presentation material.
- Demonstrate superior public speaking skills.
- Research and summarize the learning needs of the audience.
- Use presentation technologies and methods which address a variety of learning styles.
- Be aware of audience response to material and method, and adjust presentation accordingly.
- Prepare alternate plans or demonstrate the ability to improvise as required by unforeseeable circumstances during the presentation.

PROBLEM SOLVING / TROUBLESHOOTING

FOUNDATION LEARNING COMPONENT

Learner Program Outcomes

- Demonstrate the ability to identify and use a wide range of resources and techniques to identify technical problems, and develop and implement resolution plans.
- Demonstrate the ability to identify and use appropriate communication tools and methods to correctly isolate and identify technical problems.

Key Competencies

Demonstrate the ability to:

- Recognize and define the problem.
- Use a wide range of troubleshooting resources and techniques.
- Identify and isolate causes of the problem.
- Identify possible solutions to the problem, and to methodically test these solutions.
- Develop a plan to implement the solution.
- Communicate all phases of the process: including defining the problem and its cause, testing of methods and results, and planning the implementation of a solution.
- Develop recommendations based on troubleshooting process and results.

Performance Indicators - Proficiency level

Demonstrate the ability to:

- Recognize a gap between current situation and desired condition.
- Articulate specific areas of unsatisfactory performance or conflict.
- Identify the factors affecting the desired outcome.
- Discern symptoms and causes.
- Use resources in seeking solutions to the problem.
- Evaluate possible solutions relative to desired outcome.
- Outline a sequence of steps which will lead to the desired outcome in a timely manner.
- Use good oral communication skills, both one-on-one and in groups while analyzing problem and implementing solution.
- Use good written communication to document all phases of the process.
- Explain the different steps and processes used to identify the problem.

Performance Indicators - Expert level

Demonstrate the ability to:

- Consult a variety of appropriate and valid technical resources, such as technical manuals, on-line sources, and expert opinions.
- Develop a testing scheme to isolate individual variables, and clearly document methodology and results.
- Prepare a detailed presentation or report communicating the process and outcome, including relevant diagrams and references.
- Analyze the troubleshooting process and make recommendations for improvement.
- Analyze source of the problem and make recommendations to prevent recurrence of problem.

PROJECT MANAGEMENT
FOUNDATION LEARNING COMPONENT

Learner Program Outcomes

- Demonstrate an understanding of the basic phases of project management, and the ability to use appropriate project management planning tools and methods.
- Demonstrate the ability to coordinate the use of resources with other team members and groups.

Key Competencies

Demonstrate the ability to:

- Clearly define and articulate project scope and goals.
- Analyze relationships between parts and wholes.
- Identify project/task resource requirements.
- Use resources effectively.
- Map resource requirements to resource availability.
- Establish and identify milestones, benchmarks and frequency of monitoring.
- Monitor budgets, evaluate staff and monitor time.
- Identify criteria to determine the effectiveness of use of resources.
- Identify a critical path failure, and develop and implement contingencies.
- Work effectively within the system and with members of the team and organization.

Performance Indicators - Proficiency Level

Demonstrate the ability to:

- Define project goals.
- Break down a project into component tasks.
- Articulate task interdependencies.
- Organize and prioritize tasks.
- Identify and secure training needs.
- Navigate through the bureaucracy.
- Project resource needs such as human, time, budgetary and equipment resources.
- Identify and match resources to tasks.
- Establish criteria, format and timelines to monitor tasks.
- Monitor the use of resources.
- Evaluate processes and products during and at the end of the project.
- Use evaluation information to adjust activities to meet goals.

Performance Indicators - Expert Level

Demonstrate the ability to:

- Train as necessary and build project team.
- Deal with "reluctant" staff members and offer alternative solutions.
- Predict potential pitfalls.
- Establish a process for making task adjustments.
- Anticipate and resolve conflicts with parallel competing initiatives.

RESEARCH
FOUNDATION LEARNING COMPONENT

Learner Program Outcomes

- Demonstrate the ability to identify and use traditional and non-traditional sources of information.
- Demonstrate the ability to apply effectively and choose appropriately from a variety of research methods and tools.
- Demonstrate the ability to analyze, organize and present research material.

Key Competencies

Demonstrate the ability to:

- Recognize the purpose of the research and evaluate its scope based on goals and available resources.
- Identify traditional and non-traditional sources of information
- Use effectively a wide range of research strategies and sources of information.
- Use effectively oral, written and on-line sources of information.
- Analyze the information for relevance and accuracy.
- Analyze the research results for completeness.
- Recognize and reconcile conflicts between information from different sources.
- Organize and summarize the information.
- Present the research results in an appropriate format and language

Performance Indicators – Proficiency level

Demonstrate the ability to:

- Clearly state the purpose of the research for a given project.
- Estimate the scope of the research and necessary resources.
- Identify resources and topics in line with scope of the project.
- Identify and gather research from traditional sources such as books, magazines, VCR tapes and newspapers.
- Identify non-traditional sources of information such as business leaders, community leaders, museum staff, field trips and advisory committees.
- Use various Internet search engines to locate information.
- Analyze information for completeness and relevance to subject.
- Analyze information for accuracy.
- Resolve conflicts between different sources.
- Organize the information in a logical pattern.
- Summarize the information.
- Provide accurate documentation, (such as footnotes, endnote sources, reference list) in recognized format.

Performance Indicators – Expert level

Demonstrate ability to:

- Analyze the effectiveness of different research tools and sources based on the research goals.
- Use advanced search engines and strategies on the Internet.
- Reformat the research for different purposes and audiences.
- Present and analyze different points of view on a given topic.
- Use expert library indexes and guides in compiling research materials.

SELF LEARNING
FOUNDATION LEARNING COMPONENT

Learner Program Outcomes

- Demonstrate the ability to identify a self-learning path and plan experiences to meet learning goals.
- Demonstrate a knowledge of various learning styles and an understanding of one's own learning style.
- Demonstrate the ability to identify and use sources of training appropriate to meet the specific training needs.
- Demonstrate the ability to apply new learning, and to evaluate new learning in the context of learning goals.

Key Competencies

Demonstrate the ability to:

- Outline self-learning path based on personal interests, experience and context.
- Design and orchestrate learning experiences supportive of the learning path.
- Identify gaps between personal knowledge and what is needed to accomplish task or project.
- Identify the areas of self-proficiency and the pathways needed for further expansion.
- Present the differences between various learning styles
- Describe one's own learning style, and most effective learning strategies.
- Identify available training resources and forums, and select best approaches to meet goals and learning styles.
- Apply new learning in the context of the task or project.
- Evaluate effectiveness of the learning process against expectations.
- Identify the application of one's learning in society.

Performance Indicators - Proficiency Level

Demonstrate the ability to:

- Inventory personal knowledge and skills.
- Develop goals and expectations for further development of knowledge and skills.
- Analyze gaps between one's knowledge and skills and that required by the task or project.
- Design training and learning strategies to meet goals.
- Incorporate one's learning into desirable outcomes.
- Describe various learning styles.
- Describe one's learning styles.
- Select learning strategies that best meet learning goals and style.
- Identify available training resources.
- Use a wide range of learning tools and processes.
- Identify and use new roles effectively.
- Apply effectively new knowledge or skill.
- Identify learning opportunities from a wide range of contexts.

Performance Indicators - Expert Level

Demonstrate the ability to:

- Synthesize a new concept with existing knowledge to create a correct or proper end result.
- Recognize the advantages and disadvantages of following generally accepted standards.
- Reflect on and learn from experience.
- Evaluate effectiveness of one's learning against goals and expectations.

TASK MANAGEMENT
FOUNDATION LEARNING COMPONENT

Learner Program Outcomes

- Demonstrate the ability to organize and prioritize multiple tasks in the most effective way.
- Demonstrate the ability to allocate time and resources according to task complexity and priority.
- Demonstrate the ability to evaluate task outcomes and continuously improve process.

Key Competencies

Demonstrate the ability to:

- Identify tasks and their interdependencies.
- Break down tasks into activities and perform activities.
- Prioritize tasks and organize in appropriate sequence.
- Monitor and evaluate progress of each task.
- Assess successful completion of each task against standards.
- Develop monitoring indicators.
- Make process improvements and adjustments as work on task progresses.
- Estimate time to complete a task.
- Assign adequate resources to completion of task.
- Develop schedule of tasks to be completed.

Performance Indicators - Proficiency level

Demonstrate the ability to:

- List tasks.
- Prioritize tasks.
- Break each task into sub-tasks/ activities.
- Group related tasks and activities.
- Compare standards with outcome of work on a task and recognize discrepancies.
- List for each task factors indicating successful progress to completion of task.
- Estimate accurately time for task completion.
- Develop schedule of tasks based on time estimates.
- Adjust schedule to account for delays.
- Identify resources: information resources, human resources, tools (software, hardware, other).
- Apply resources to task appropriately.
- Complete task in accordance with standard and timeline.

Performance Indicators - Expert level

Demonstrate the ability to:

- Extrapolate from knowledge of simple tasks to planning of complex tasks.
- Estimate accurately time to complete complex tasks.
- Use task management tools to organize tasks and allocate resources.
- Apply professional standards to measure outcomes.
- Develop a plan and an alternate plan to complete goals.
- Justify time estimates using previous experience.
- Develop time estimates when previous experience does not apply.

TEAM WORK

FOUNDATION LEARNING COMPONENT

Learner Program Outcomes

- Demonstrate the ability to organize and work in a team setting.
- Demonstrate the ability to recognize expertise and to learn from others, and demonstrate collaborative decision making.
- Demonstrate the ability to work and communicate effectively with persons of different backgrounds.

Key Competencies

Demonstrate the ability to:

- Use effective communication skills when interacting in a team environment.
- Risk exposure of one's ideas, recognize that others are taking risks as well, and respect the opinion and feeling of others.
- Explain group dynamics, team processes, and different roles within a team and their purpose.
- Work collaboratively to set team goals, showing flexibility in accepting others' leadership.
- Evaluate fairly others' ideas when they are in conflict with one's own.
- Manage conflicts that arise, and maintain and build on the team process.
- Learn from others' and build on others' expertise and strengths.
- Comprehend/interpret meaning when ideas are expressed from diverse cultural, ethnic or linguistic perspectives.
- Respect different styles of communication and actively encourage contribution from all team members.

Performance Indicators - Proficiency level

Demonstrate the ability to:

- Explain the use of formal brainstorming techniques.
- Listen attentively without interrupting the speaker.
- Express one's ideas effectively orally.
- Judge when to ask for clarification.
- Use a variety of techniques to obtain clarification (paraphrase, direct question).
- Be non-judgmental and open to all ideas.
- Filter good ideas from inappropriate or non-productive ideas.
- Show an awareness of and respect for cultural, ethnic, and linguistic diversity.
- Organize and prioritize ideas which have been generated by the group.
- Draw out ideas and input from others.
- Articulate roles and their functions.

Performance Indicators - Expert level

Demonstrate the ability to:

- Explain the differences in communication styles and how they benefit the overall team.
- Recognize and actively build on team members' various strengths and expertise.
- Summarize and present group decisions both orally and in written form.
- Recognize conflicts and apply appropriate resolution strategies.
- Assume a variety of roles within a team.
- Engage team members who are reluctant to participate, especially when those team members are from diverse cultural, ethnic or linguistic backgrounds.
- Define the functions of each role within a team and assign members to these roles.

TESTING/VALIDATION
FOUNDATION LEARNING COMPONENT

Learner Program Outcomes

- Demonstrate an understanding of the fundamental principles of testing methodology.
- Demonstrate the ability to effectively apply a wide range of testing methods and tools.
- Demonstrate the ability to choose the testing methods and tools most appropriate for the scope and purpose of project.
- Demonstrate the ability to interpret test results, and communicate results and consequences.

Key Competencies

Demonstrate the ability to:

- Explain the key characteristics of valid testing procedures.
- Give examples of and compare different testing procedures and tools.
- Assess a testing tool/process for applicability to a particular task.
- Create a sequential outline or flowchart, including timelines, for the testing process.
- Select and follow a defined testing procedure.
- Use a wide range of testing tools and procedures.
- Accurately and completely record all feedback in a usable format, without editing or bias.
- Recognize trends and groupings in data, and identify information which is relevant to answering the initial query.
- Reach a conclusion which is relevant to answering the initial query.
- Use and/or communicate data and conclusions to facilitate the taking of corrective steps or making needed modifications.

Performance Indicators – Proficiency level

Demonstrate the ability to:

- Explain the principles of testing methodology.
- Explain statistical concepts and terms involved in testing such as randomness of samples, isolated variables, non-biased sample.
- Evaluate testing tools for validity of method. (Does it measure what it is supposed to? Is feedback accurate?)
- Identify/choose a tool which is appropriate in scope and methodology to generate the desired feedback.
- Outline all the steps of the testing process.
- Apply a testing method/tool and follow procedures.
- Record all feedback accurately and completely.
- Analyze data using statistical methods.
- Evaluate data, and reach accurate, relevant conclusions.
- Use test results to develop modifications as required.
- Communicate conclusions to those responsible for taking corrective action.

Performance Indicators – Expert level

Demonstrate ability to:

- Develop a testing plan/procedure to fulfill specific criteria.
- Employ advanced testing tools, such as cost/benefit analysis and software regression tests.
- Demonstrate advanced knowledge of system being tested.
- Make recommendations for improvement of the testing processes and/or tools.

WORKPLACE SKILLS
FOUNDATION LEARNING COMPONENT

Learner Program Outcomes

- Demonstrate the ability to work successfully in the workplace.
- Demonstrate leadership skills, where applicable, and show flexibility in accepting others' leadership.
- Demonstrate the ability to accept responsibility for one's own behavior and be aware of its impact on others.

Key Competencies

Demonstrate the ability to:

- Accept responsibility for one's own behavior and evaluate its impact on others.
- Produce work that is thorough, accurate, complete, and meets the quality standards of the organization.
- Improve continuously the quality of products and processes.
- Seek self-improvement.
- Involve others in cooperative team efforts and consider their ideas.
- Establish and maintain productive work relationships with all members of the organization.
- Treat people with fairness, trust, and respect, and honor commitments.
- Achieve results through personal example, and delegate responsibility where applicable.
- Evaluate objectives, alternatives, and solutions carefully before making decisions.
- Use good judgment to make timely and effective decisions.
- Show support for the workplace, team missions and objectives through personal example.
- Exhibit active commitment to ethics, equal opportunity, the workplace and the team, as well as community responsibilities.

Performance Indicators - Proficiency Level

Demonstrate the ability to:

- Evaluate and explain impact of one's own behavior on others.
- Accept responsibilities for one's behavior and actions.
- Produce work that meets the standards of the organization and the expectations of the specific assignment.
- Work effectively in teams and build on ideas from other members of the organization.
- Show respect to and cooperation with other members of the organization.
- Honor commitments.
- Base decisions on sound analysis methods.
- Use communication effectively and appropriately.
- Exhibit ethics and loyalty to self, the organization and the community.

Performance Indicators - Expert Level

Demonstrate the ability to:

- Propose and apply strategies for improvement of work and team processes.
- Change behavior to affect change in behavior in others.
- Produce work that exceeds the standards of the organization.
- Recognize need for help and offer it to others.
- Use good evaluation and judgment skills and seeks others' feedback.
- Show active support of the team and organization's goals and objectives.
- Explain and apply the principles of equal opportunity in all interactions.
- Show leadership through example.

SAMPLE ACTIVITIES

- **Description of Activity**
- **Relevant Key Competencies**

Each Sample Activity integrates competencies from several Learning Components. Emphasis was placed on integrating competencies from the Technical Learning Components with competencies from the Foundation Learning Components.

The primary development of foundation skills should occur within the context of solving real-world problems. Therefore, this model integrates the technical knowledge and foundation skills through activities in the teaching/learning process. The student sees the context for learning foundation skills as well as the technical knowledge; being an effective team member, problem-solver, and/or self-learner has a purpose, context, and connection that provides motivation for holistic learning. In the work environment, competencies from various areas are used together in conjunction and, therefore, should be learned in an integrated manner whenever possible rather than in isolation.

SAMPLE ACTIVITY #1

You have been asked to head the development and implementation of a database product that will enable the students in your class to exchange CDs. You will be working with a small team of students who have been assigned to the project. You will also be responsible for training the students in using the database.

The requirements for the product are as follows:

- The database will be easy to use and will be secure.
- The design of the database will be responsive to the needs of the users.
- The design, implementation, and training timeline and resources will be presented to the teacher for approval.
- The database will enable students to list the CDs they own and are willing to share with others.
- The database will keep track of CDs borrowed, when and by whom.
- The database will be tested by a set of students before full-scale implementation.
- The training will be designed to meet the learning styles of the majority of the students, as well as time and resource constraints.
- Recommendations for a support team will be made to the class and teacher to maintain the database product after its implementation.
- Design and maintenance recommendations will be fully documented.

Database

- Design, create, and use relational databases.
- Create and edit tables.
- Develop and modify queries.
- Use queries to analyze data.
- Design and modify forms.
- Create and format reports.
- Design databases to meet the needs of specific applications and users.

Presentation Software

- Create presentation slides and handouts.
- Create effective presentations communicating clearly the topic.

Word Processing

- Create, edit, save, retrieve, and print documents.
- Use word-processing utility tools including spell checker, thesaurus, and grammar checker.
- Create business documents in standard formats and styles.

Analysis

- Evaluate requirements and identify missing or conflicting information.
- Identify time, technology, and resource constraints, in general terms.

Design/Development

- Use a variety of analysis and design tools, such as data flow diagrams and prototyping.
- Perform the necessary steps in the design/development process.
- Compare prototype with design requirements and make recommendations.

Documentation and Business Communication

- Organize communication in a logical sequence, and support communication with necessary data.
- Use clear, focused, specific and grammatically correct language and terminology.
- Display attitudes that foster effective communication.

Facilitation/Customer Service

- Interpret and define the customer's needs and communicate information to relevant groups of the organization.

Organization/Delivery of Presentations

- Organize the presentation so that the material is complete, logically sequenced and meets presentation timelines.
- Deliver the presentation using good speaking skills and appropriate technology to enhance the delivery of the content.

Project Management

- Clearly define and articulate project scope and goals.
- Analyze relationships between parts and wholes.
- Identify project/task resource requirements.
- Use resources effectively.
- Work effectively within the system and with members of the team and organization.

Team Work

- Use effective communication skills when interacting in a team environment.
- Risk exposure of one's ideas, recognize that others are taking risks as well, and respect the opinion and feeling of others.
- Work collaboratively to set team goals, showing flexibility in accepting others' leadership.
- Manage conflicts that arise, and maintain and build on the team process.
- Respect different styles of communication and actively encourage contribution from all team members.

Testing/Validation

- Select and follow a defined testing procedure.
- Accurately and completely record all feedback in a usable format, without editing or bias.
- Reach a conclusion which is relevant to answering the initial query.
- Use and/or communicate data and conclusions to facilitate the taking of corrective steps or making needed modifications.

SAMPLE ACTIVITY #2

Your school is looking into migrating its standalone computers into a networked system. You have been asked to participate in a team of teachers and students to research the networking options and make recommendations. The research will be thoroughly documented and recommendations will be presented to a review panel of the school administrators who may not be highly computer knowledgeable. As a member of the team you will participate in all phases: research, analysis, documentation, and presentation. As the timeline for this project is very tight, members of the team need to work efficiently in selecting and completing tasks.

The main factors in selecting a system will include:

- Cost of network hardware and software
- Cost of migration process
- Ease of maintaining the system
- Flexibility of system and possibility of system expansion
- Security of system

Computer Trends in Business and Society

- Discuss trends affecting computers and the information processing industry.
- Describe how business information systems are likely to change in the future.

Network Technologies

- Present and explain the design and features of LAN & WAN systems.
- Determine the type of network topology needed, such as peer-to-peer and server based.
- Explain the type of wiring needed for the physical connection of the network.

Presentation Software

- Create effective presentations communicating clearly the topic.

Word Processing

- Create, edit, save, retrieve, and print documents.
- Use word-processing utility tools including spell checker, thesaurus, and grammar checker.
- Create business documents in standard formats and styles.

Analysis

- Evaluate requirements and identify missing or conflicting information.
- Analyze and synthesize information and make recommendations.
- Develop risk analysis and demonstrate flexibility in adopting alternative strategies.
- Determine whether further analysis is necessary and support recommendations.
- Communicate and document information and the recommendations.

Documentation and Business Communication

- Organize communication in a logical sequence, and support communication with necessary data.
- Display attitudes that foster effective communication.

Organization/Delivery of Presentations

- Deliver the presentation using good speaking skills and appropriate technology to enhance the delivery of the content.

Research

- Recognize the purpose of the research and evaluate its scope based on goals and available resources.
- Use effectively a wide range of research strategies and sources of information.
- Use effectively oral, written, and on-line sources of information.
- Analyze the information for relevance and accuracy.
- Analyze the research results for completeness.
- Recognize and reconcile conflicts between information from different sources.
- Organize and summarize the information.
- Present the research results in an appropriate format and language.

Task Management

- Estimate time to complete a task.
- Develop schedule of tasks to be completed.

Team Work

- Use effective communication skills when interacting in a team environment.
- Risk exposure of one's ideas, recognize that others are taking risks as well, and respect the opinion and feeling of others.
- Work collaboratively to set team goals, showing flexibility in accepting others' leadership.
- Evaluate fairly others' ideas when they are in conflict with one's own.
- Respect different styles of communication and actively encourage contribution from all team members.

Workplace Skills

- Produce work that is thorough, accurate, complete, and meets the quality standards of the organization.
- Involve others in cooperative team efforts and consider their ideas.
- Establish and maintain productive work relationships with all members of the organization.
- Treat people with fairness, trust, and respect, and honor commitments.
- Use good judgment to make timely and effective decisions.
- Show support for the workplace, team missions and objectives through personal example.

SAMPLE ACTIVITY #3

Your school has decided to migrate to a new spreadsheet software. You are the treasurer for the newspaper club and need to transfer your data into the new format to be compatible with the rest of the institution. Based on the availability of resources and your time, you decide to learn the new software by trial-and-error with the support of the on-line help. You obtain a copy of the new software and install it on your PC without any problem. After transferring the data, you accidentally erase the file in the old software format and find that your last backup is very outdated. The treasurer's report is due in two days and you soon realize that the transition of your data into the new software was not error free. You need to find a way to rapidly learn enough about the basics in this new software to be functional, and to fix the problems in the transferred spreadsheet.

Resources available to you are:

- The on-line help
- A brief tutorial included with the software package
- The technical support phone-in service from the vendor
- A few knowledgeable users on campus who are very busy delivering training – your best bet is to try to reach them through e-mail

E-mail

- Send, receive, reply, forward, save, delete messages.

Software Installation/Configuration

- Choose between default and custom installation options.
- Configure software to appropriate operating system settings.
- Research and obtain help from manufacturers' technical help lines.

Spreadsheet

- Develop, edit, save, retrieve, and print spreadsheets.
- Use simple and advanced formulas.
- Troubleshoot spreadsheets and resolve errors.
- Import and export data and objects to/from other applications.

Documentation and Business Communication

- Evaluate and effectively use various communication techniques and formats.
- Organize communication in a logical sequence, and support communication with necessary data.
- Display attitudes that foster effective communication.

Problem Solving/Troubleshooting

- Recognize and define the problem.
- Use a wide range of troubleshooting resources and techniques.
- Identify and isolate causes of the problem.
- Identify possible solutions to the problem, and to methodically test these solutions.

Research

- Identify traditional and non-traditional sources of information.
- Use effectively a wide range of research strategies and sources of information.
- Use effectively oral, written, and on-line sources of information.
- Analyze the information for relevance and accuracy.
- Recognize and reconcile conflicts between information from different sources.

Self-Learning

- Identify gaps between personal knowledge and what is needed to accomplish task or project.
- Identify available training resources and forums, and select best approaches to meet goals and learning styles.
- Apply new learning in the context of the task or project.

Task Management

- Break down tasks into activities and perform activities.
- Prioritize tasks and organize in appropriate sequence.
- Monitor and evaluate progress of each task.
- Develop monitoring indicators.

Testing/Validation

- Select and follow a defined testing procedure.
- Use a wide range of testing tools and procedures.
- Use and/or communicate data and conclusions to facilitate the taking of corrective steps or making needed modifications.

MATH AND SCIENCE LEARNER PROGRAM OUTCOMES AND KEY COMPETENCIES

Math and Science competencies relevant to the learning of Information Technology were selected from the *New Standard™ Performance Standards*, volume 3 — 1997, with permission from the National Center on Education and the Economy and the University of Pittsburgh.

MATHEMATICAL PROBLEM SOLVING

Learner Program Outcome

Demonstrates problem-solving by using mathematical concepts and skills to solve non-routine problems that do not have specific and detailed steps to follow, and solves problems that make demands on all three aspects of the solution process—formulation, implementation and conclusion.

Key Competencies

Formulation

The student participates in the formulation of problems; that is, given the statement of a problem situation, the student:

- fills out the formulation of a definite problem that is to be solved
- extracts pertinent information from the situation as a basis for working on the problem
- asks and answers a series of appropriate questions in pursuit of a solution and does so with minimal "scaffolding" in the form of detailed guiding questions

Implementation

The student makes the basic choices involved in planning and carrying out a solution; that is, the student:

- chooses and employs effective problem-solving strategies in dealing with non-routine and multi-step problems
- selects appropriate mathematical concepts and techniques from different areas of mathematics and applies them to the solution of the problem
- applies mathematical concepts to new situations within mathematics and uses mathematics to model real-world situations involving basic applications of mathematics in the physical and biological sciences, the social sciences, and business

Conclusion

The student provides closure to the solution process through summary statements and general conclusion; that is, the student:

- concludes a solution process with a useful summary of results
- evaluates the degree to which the results obtained represent a good response to the initial problem
- formulates generalization of the results obtained
- carries out extensions of the given problem to related problems

Source: Adapted from *New Standard™ Performance Standards*, volume 3. Copyright 1997 by the National Center on Education and the Economy and the University of Pittsburgh.

MATHEMATICAL REASONING

Learner Program Outcome

Demonstrates mathematical reasoning by using logic to prove specific conjectures, by explaining the logic inherent in a solution process, by making generalizations and showing that they are valid, and by revealing mathematical patterns inherent in a situation. The student not only makes observations and states results but also justifies or proves why the results hold in general.

Key Competencies

- Employs forms of mathematical reasoning and proof appropriate to the solution of the problem, including deductive and inductive reasoning, making and testing conjectures, and using counterexamples and indirect proof.
- Differentiates clearly between giving examples that support a conjecture and giving a proof of the conjecture.

Source: Adapted from *New Standard™ Performance Standards*, volume 3. Copyright 1997 by the National Center on Education and the Economy and the University of Pittsburgh.

MATHEMATICAL SKILLS AND TOOLS

Learner Program Outcome

The student demonstrates fluency with basic and important skills by using these skills accurately and automatically, and demonstrates practical competence and persistence with other skills by using them effectively to accomplish a task, perhaps referring to notes or books, perhaps working to reconstruct a method.

Key Competencies

- Carries out numerical calculation and symbol manipulations effectively, using mental computations, pencil and paper, or other technological aids, as appropriate.
- Uses a variety of methods to estimate the values, in appropriate units, of quantities met in applications, and rounds numbers used in applications to an appropriate degree of accuracy.
- Evaluates and analyzes formulas and functions of many kinds, using both pencil and paper and more advanced technology.
- Uses basic geometric terminology accurately, and deduces information about basic geometric figures in solving problems.
- Makes and uses rough sketches, schematic diagrams, or precise scale diagrams to enhance a solution.
- Uses the number line and Cartesian coordinates in the plane and in space.
- Creates and interprets graphs of many kinds, such as function graphs, circle graphs, scatter plots, regression lines, and histograms.
- Sets up and solves equations symbolically and graphically.
- Knows how to use algorithms in mathematics, such as the Euclidean Algorithm.
- Uses technology to create graphs or spreadsheets that contribute to the understanding of a problem.
- Writes a sample computer program to carry out a computation or simulation to be repeated many times.
- Uses tools such as rulers, tapes, compasses, and protractors in solving problems.
- Knows standard methods to solve basic problems and uses these methods in approaching more complex problems.

Source: Adapted from *New Standard™ Performance Standards*, volume 3. Copyright 1997 by the National Center on Education and the Economy and the University of Pittsburgh.

MATHEMATICAL COMMUNICATION

Learner Program Outcome

The student uses the language of mathematics, its symbols, notations, graphs, and expressions, to communicate through reading, writing, speaking, and listening, and communicates about mathematics by describing mathematical ideas and concepts and explaining reasoning and results.

Key Competencies

- Is familiar with basic mathematical terminology, standard notation and use of symbols, common conventions for graphing, and general features of effective mathematical communication styles.
- Uses mathematical representations with appropriate accuracy, including numerical tables, formulas, functions, equations, charts, graphs and diagrams.
- Organizes work and presents mathematical procedures and results clearly, systematically, succinctly, and correctly.
- Communicates logical arguments clearly, showing why a result makes sense and why the reasoning is valid.
- Presents mathematical ideas effectively both orally and in writing.
- Explains mathematical concepts clearly enough to be of assistance to those who may be having difficulty with them.
- Writes narrative accounts of the history and process of work on a mathematical problem or extended project.
- Writes succinct accounts of the mathematical results obtained in a mathematical problem or extended project, with diagrams, graphs tables, and formulas integrated into the text.
- Keeps narrative accounts of process separate from succinct accounts of results, and realizes that doing so can enhance the effectiveness of each.
- Reads mathematics texts and other writing about mathematics with understanding.

Source: Adapted from *New Standard™ Performance Standards*, volume 3. Copyright 1997 by the National Center on Education and the Economy and the University of Pittsburgh.

SCIENTIFIC THINKING

Learner Program Outcome

The student demonstrates skill in scientific inquiry and problem-solving by using thoughtful questioning and reasoning strategies, common sense and diverse conceptual understanding, and appropriate ideas and methods to investigate science.

Key Competencies

- Frames questions to distinguish cause and effect; and identifies or controls variables in experimental and non-experimental research settings.
- Uses concepts from physical and biological sciences to explain a variety of observations and phenomena.
- Uses evidence from reliable sources to develop descriptions, explanations, and models; and makes appropriate adjustments and improvements based on additional data or logical arguments.
- Proposes, recognizes, analyzes, considers, and critiques alternative explanations; and distinguishes between fact and opinion.
- Identifies problems; proposes and implements solutions; and evaluates the accuracy, design and outcomes of investigations.
- Works individually and in teams to collect and share information and ideas.

Source: Adapted from *New Standard™ Performance Standards*, volume 3. Copyright 1997 by the National Center on Education and the Economy and the University of Pittsburgh.

SCIENTIFIC TOOLS AND TECHNOLOGIES

Learner Program Outcome

The student demonstrates competence with the tools and technologies of science by using them to collect data, make observations, analyze results, and accomplish tasks effectively.

Key Competencies

- Uses technology and tools (such as traditional laboratory equipment, video, and computer aids) to observe and measure objects, organisms, and phenomena, directly, indirectly, and remotely, with appropriate consideration of accuracy and precision.
- Records and stores data using a variety of formats, such as data bases, audio tapes, and videotapes.
- Collects and analyzes data using statistical concepts and techniques, such as mean, median, and mode; outcome probability and reliability; and appropriate data displays.
- Acquires information from multiple sources, such as print, Internet, computer data bases, and experimentation.
- Recognizes and limits sources of bias in data, such as observer and sample biases.

Source: Adapted from *New Standard™ Performance Standards*, volume 3. Copyright 1997 by the National Center on Education and the Economy and the University of Pittsburgh.

SCIENTIFIC COMMUNICATION

Learner Program Outcome

The student demonstrates effective scientific communication by clearly describing aspects of the natural world using accurate data, graphs, or other appropriate media to convey depth of conceptual understanding in science.

Key Competencies

- Represents data and results in multiple ways, such as numbers, tables, and graphs; drawings, diagrams and artwork; technical and creative writing; and selects the most effective way to convey the scientific information.
- Argues from evidence, such as data produced through his or her own experimentation or data produced by other.
- Critiques published materials, such as popular magazines and academic journals.
- Explains a scientific concept or procedure to other students.
- Communicates in a form suited to the purpose and the audience, such as writing instructions that other scan follow; critiquing written and oral explanations; and using data to resolve disagreements.

Source: Adapted from *New Standard™ Performance Standards*, volume 3. Copyright 1997 by the National Center on Education and the Economy and the University of Pittsburgh.

APPENDICES

APPENDIX I: GLOSSARY

Assessment
The process of quantifying, describing, or gathering information about performance.

Career Cluster
A career area that includes multiple positions and titles, and is applicable in various organizations and industries.

Competency-based Education
An "educational system that emphasizes the specification, learning and demonstration of those competencies (knowledge, skills, and behavior) that are of central importance to a given task, activity, or career" (*Thesaurus of ERIC Descriptors*).

Context (of a performance assessment)
The surrounding circumstances within which the performance is embedded. For example, problem-solving/troubleshooting can be assessed in the context of specific technical content (e.g., PC principles and operations, spreadsheet) or in the context of a real-life laboratory problem requiring the use of math, science, and communication skills.

Curriculum Development Framework
A working model that describes the flow of curriculum activities using skill standards as a foundation.

DACUM (Developing A Curriculum)
A process used to identify the primary functions and tasks within a career cluster.

Foundation Skills
Basic academic and employability skills learners need to be effective in the modern workplace. Foundation skills, based largely on SCANS, are often areas of "process" development (e.g., critical thinking, teamwork, communication) in the curriculum.

Information Technology
"...Encompasses all the technologies used for creating, abstracting, visualizing, presenting, collaborating, communicating, and otherwise 'managing' the flow of information." (John Viulami, *The World of Information Technology*).

Integrated Curriculum
A meaningful way of organizing curriculum content, for example, the integration of technical learning components and foundation or workplace skills.

Key Competencies
Specific, observable behaviors, knowledge, abilities, and skills that detail and support the learner program outcomes. Learner attainment of key competencies lead to the successful completion of program outcomes.

Learning Component
Key teaching/learning areas (meaningful categories of related skills and knowledge) that reflect curricular emphasis. Learning components emphasize either technical knowledge (e.g., business knowledge, word processing) or foundation skills (problem-solving/ troubleshooting, written communication).

Learner Program Outcomes
Statements that support each of the major learning components by describing what learners must know and be able to do by the end of the program. Two additional levels of detail support the learner program outcomes: key competencies and performance indicators. Learner program outcomes are determined through input from industry skill standards, course syllabi, local advisory boards, subject matter experts, etc.

Outcome
A goal statement specifying desired knowledge, skills/processes, and attitudes to be developed as a result of education experiences.

Performance Assessment
Direct observation of student performance or student work and professional judgment of the quality of that performance. Quality performance assessment has pre-established performance criteria.

Performance Indicators
Specific criteria, or characteristics, that detail and support the key competencies, and constitute evidence of learning. Performance indicators may be used to assess learner attainment of skill and knowledge competencies. The performance indicators are divided into two levels of mastery, proficiency and expert.

Sample Activities
Learning activities, scenarios, projects, and/or assignments that provide a context for what learners will do to develop abilities, gain knowledge, and practice what they are learning. Pertinent key competencies and supporting performance indicators may be specified for each sample activity.

Sample Assessments
Learner activities that demonstrate learning. Performance assessment activities (comparing learner performance to the performance standard) that include learner program outcomes for both technical knowledge and foundation skills. Pertinent key competencies and supporting performance indicators may be specified for each sample assessment.

SCANS
(*Secretary's Commission on Achieving Necessary Skills*). A 1991 federal report that identifies skills and competencies necessary for work readiness in any career area. The skills are divided into foundation skills (basic skills, thinking skills, and personal qualities) and workplace competencies (allocating resources, interpersonal skills, using information, and understanding social, organizational, and technological systems).

Skill Standards
Employer-generated and accepted levels of performance required for success in a particular occupation. Standards set by industries typically define core competencies and the related knowledge and skills integral to specific jobs.

Tech Prep

A planned sequence of study which begins in high school and continues through to the postsecondary level. The program is designed to ensure that students have the opportunity to continue their education (without duplication or repetition) based on a continuum of knowledge, skills, and attitudes learned in high school.

Technical Knowledge

Knowledge, skills, abilities, attitudes, and appropriate use of tools that learners must achieve to be effective in a work-related context. Technical knowledge areas are often addressed as "discipline-specific content" in the curriculum.

Workplace Readiness

Nontechnical skills that employers indicate would be valuable for any worker to have — reliability, critical thinking and problem-solving, understanding of bottom-line accountability, and the ability to be a team player and self-starter. They are often mentioned by employers as basic to occupational success.

APPENDIX 2:
CORE SKILL STANDARDS

How to read the Skill Standards Charts

FUNCTION
Functions represent the general areas of responsibility for an IT worker.
The Functions tell us what must be accomplished to achieve the key purpose of most IT occupations.

TASK
Tasks are duties related to the functional area of the work. Tasks are a listing of the key activities performed by IT workers. A task is made up of measurable and observable work activities which end in a product, service, or decision.

PERFORMANCE CRITERIA
Performance Criteria are specific behavioral evidence of a worker's achievement of skills, knowledge, and tasks. The functions and tasks begin to reflect a picture of work requirements for the IT worker, but that is not enough. To create standards, "competent performance" must be described. The question that is answered by this component of the skill standards is "How do we know when the task is well performed?"

TECHNICAL KNOWLEDGE
This column lists the specific technical knowledge, skills, abilities, attitudes, and tools that must be mastered by workers to perform successfully a given occupational task.

FOUNDATION SKILLS AND PERSONAL QUALITIES
Foundation skills are basic academic and employability skills that are needed to build more advanced competencies. Foundation skills are competencies required by workers in order to obtain meaningful work and participate in the modern workforce.

FUNCTION: RESEARCH

TASK	PERFORMANCE CRITERIA *How do we know when the task is performed well?*	TECHNICAL KNOWLEDGE *Skills, Abilities, Tools*	FOUNDATION SKILLS AND PERSONAL QUALITIES
B1. Frame research questions	■ *Gaps in necessary information are identified* ■ *Research questions are clearly focused, and relevant to the project needs* ■ *Research methods, time, resources are identified and appropriate*	■ *Ability to synthesize information into clear research questions* ■ *Knowledge of research techniques and tools* ■ *Knowledge of online resources and search techniques*	■ *Ability to generalize information* ■ *Ability to compare multiple viewpoints* ■ *Ability to pose critical questions* ■ *Ability to understand goals and focus questions*
B2. Identify and evaluate sources of information	■ *Sources of information are credible, accessible and can provide relevant information*	■ *Ability to understand technical specifications* ■ *Ability to evaluate relevance of sources of information* ■ *Ability to be creative in resource identification*	■ *Ability to identify and prioritize the need for data* ■ *Ability to analyze information for accuracy and consistency* ■ *Ability to recognize information most relevant and important to a situation*
B3. Gather, analyze and compile information	■ *Information is analyzed and evaluated for coherence and completeness* ■ *Information gathered is relevant and accurate* ■ *Information provides the necessary contextual background* ■ *Information is compiled and summarized, and conclusions are drawn to meet the project needs*	■ *Ability to see conflicts and integration capabilities between diverse products and techniques* ■ *Ability to organize and assess importance and relevancy of product information* ■ *Knowledge of hardware and software products*	■ *Ability to analyze and synthesize information* ■ *Ability to create clear and concise documentation*

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FUNCTION: ANALYSIS

TASK	PERFORMANCE CRITERIA *How do we know when the task is performed well?*	TECHNICAL KNOWLEDGE *Skills, Abilities, Tools*	FOUNDATION SKILLS AND PERSONAL QUALITIES
A1. Gather data to identify requirements, and interpret, evaluate and confirm requirements	■ *Project requirements and objectives are identified, clarified and agreed upon* ■ *Conflicting requirements are identified and resolved* ■ *Critical questions are asked, information is checked for correctness, and revisions are made as needed* ■ *Sources and methods for gathering information are affordable and relevant* ■ *Information is accurate and complete* ■ *Criteria for successful completion of project is clearly identified and agreed upon*	■ *Ability to identify key sources of information* ■ *Ability to apply information gathering methods* ■ *Ability to decide when enough information has been gathered* ■ *Knowledge of workplace and industry vocabulary* ■ *Ability to obtain customer approval of requirements* ■ *Ability to resolve conflicts in available information and expressed needs* ■ *Knowledge of hardware and software* ■ *Ability to clarify business objectives*	■ *Ability to pose critical questions* ■ *Ability to compile and analyze multiple viewpoints* ■ *Ability to identify and prioritize the need for data* ■ *Ability to encourage cooperation and keep an open mind to new data and opinions* ■ *Ability to relate intent to desired results* ■ *Ability to analyze information for accuracy and consistency* ■ *Ability to recognize information most relevant and important to a situation* ■ *Ability to accurately summarize and document information* ■ *Ability to interpret and clarify communication*
A2. Define scope of work to meet requirements	■ *Required type, amount and quality of the work are identified and realistic* ■ *Major project tasks, and task interdependencies and priorities are identified* ■ *Rationale for estimates of time and resources are clearly understood*	■ *Ability to visualize tasks sequentially and identify interdependencies* ■ *Ability to evaluate work procedures for effectiveness and efficiency* ■ *Ability to estimate required resources and schedule* ■ *Ability to plan according to people and resource needs and constraints*	■ *Ability to create detailed supporting documents* ■ *Ability to predict outcomes/results based on experience or prior knowledge* ■ *Ability to negotiate alternatives* ■ *Ability to prioritize conflicting work demands* ■ *Ability to identify the purpose and scope of the assignment*
A3. Identify time, technology and resource constraints	■ *Needed and available resources are assessed* ■ *Possible problems are identified, and contingency plans are outlined*	■ *Ability to identify and plan resources* ■ *Knowledge of technology constraints* ■ *Knowledge of operating systems, application software and Internet capabilities* ■ *Ability to identify potential sources of problems or conflicts*	■ *Ability to create detailed supporting documents* ■ *Ability to predict outcomes/results based on experience or prior knowledge* ■ *Ability to understand constraints, generate alternatives, consider risks and evaluate options* ■ *Ability to evaluate project time frames*

FUNCTION: RESEARCH

TASK	PERFORMANCE CRITERIA *How do we know when the task is performed well?*	TECHNICAL KNOWLEDGE *Skills, Abilities, Tools*	FOUNDATION SKILLS AND PERSONAL QUALITIES
B1. Frame research questions	■ *Gaps in necessary information are identified* ■ *Research questions are clearly focused, and relevant to the project needs* ■ *Research methods, time, resources are identified and appropriate*	■ *Ability to synthesize information into clear research questions* ■ *Knowledge of research techniques and tools* ■ *Knowledge of online resources and search techniques*	■ *Ability to generalize information* ■ *Ability to compare multiple viewpoints* ■ *Ability to pose critical questions* ■ *Ability to understand goals and focus questions*
B2. Identify and evaluate sources of information	■ *Sources of information are credible, accessible and can provide relevant information*	■ *Ability to understand technical specifications* ■ *Ability to evaluate relevance of sources of information* ■ *Ability to be creative in resource identification*	■ *Ability to identify and prioritize the need for data* ■ *Ability to analyze information for accuracy and consistency* ■ *Ability to recognize information most relevant and important to a situation*
B3. Gather, analyze and compile information	■ *Information is analyzed and evaluated for coherence and completeness* ■ *Information gathered is relevant and accurate* ■ *Information provides the necessary contextual background* ■ *Information is compiled and summarized, and conclusions are drawn to meet the project needs*	■ *Ability to see conflicts and integration capabilities between diverse products and techniques* ■ *Ability to organize and assess importance and relevancy of product information* ■ *Knowledge of hardware and software products* ■ *Knowledge of word processing software*	■ *Ability to analyze and synthesize information* ■ *Ability to create clear and concise documentation*

FUNCTION: DESIGN/DEVELOPMENT

TASK	PERFORMANCE CRITERIA *How do we know when the task is performed well?*	TECHNICAL KNOWLEDGE *Skills, Abilities, Tools*	FOUNDATION SKILLS AND PERSONAL QUALITIES
C1. Research and evaluate design alternatives	■ *Design alternatives are generated, and evaluated for performance and cost effectiveness* ■ *Limitations and tradeoffs are explicit*	■ *Knowledge of risk analysis techniques* ■ *Knowledge of design concepts and techniques* ■ *Knowledge of research techniques and procedures* ■ *Ability to translate technical features into development and user benefits* ■ *Knowledge of hardware and software* ■ *Ability to analyze design* ■ *Knowledge of user requirements*	■ *Ability to identify key sources of information* ■ *Ability to accurately summarize and document information* ■ *Ability to evaluate effectiveness of alternatives* ■ *Ability to predict outcomes/results based on experience or prior knowledge*
C2. Select design methodology and tools	■ *Design methodology and tools are cost efficient and adequate for scope of work* ■ *Necessary resources are available within the scope and budget of the project*	■ *Knowledge of design methodology and tradeoffs* ■ *Knowledge of resource availability* ■ *Knowledge of strengths and limitations of available tools*	■ *Ability to evaluate options and make decisions* ■ *Ability to develop creative solutions and demonstrate resourcefulness* ■ *Ability to validate selection* ■ *Ability to predict outcomes and results of selection of tools* ■ *Ability to formulate new ideas/designs*
C3. Create and test models and prototypes	■ *Prototype design accurately reflects the project requirements* ■ *Models and prototypes are developed, tested and approved* ■ *Design and test results are clearly communicated and documented*	■ *Ability to use appropriate modeling tools* ■ *Knowledge of simulation and testing procedures for prototypes* ■ *Knowledge of testing tools and methods* ■ *Ability to resolve technical conflicts* ■ *Ability to evaluate results and generate recommendations* ■ *Knowledge of measurement error analysis* ■ *Ability to recognize problems identified by test procedure*	■ *Ability to generate creative solutions and rethink traditional approaches* ■ *Ability to use logic to draw conclusions from test results* ■ *Ability to judge relevance and effectiveness of test plan* ■ *Ability to troubleshoot* ■ *Ability to monitor/adjust task sequence* ■ *Ability to propose/formulate test process* ■ *Ability to analyze data, see trends and relationships* ■ *Ability to record and document testing results*

FUNCTION: DESIGN/DEVELOPMENT

TASK	PERFORMANCE CRITERIA *How do we know when the task is performed well?*	TECHNICAL KNOWLEDGE *Skills, Abilities, Tools*	FOUNDATION SKILLS AND PERSONAL QUALITIES
C4. Select final design option	■ *Rationale for design selection is communicated and documented* ■ *Design option meets project requirements*	■ *Knowledge of user requirements* ■ *Ability to analyze design* ■ *Ability to understand user's preferences and expertise level* ■ *Ability to relate design to performance predictions*	■ *Ability to present technical information and negotiate with team members and customers* ■ *Ability to validate selection* ■ *Ability to integrate multiple items of data and reconcile conflicting information* ■ *Ability to consider risks and implications* ■ *Ability to resolve technical issues* ■ *Ability to present information persuasively and objectively*
C5. Decide to make or buy elements	■ *Decisions are congruent with project goals, scope, timeline and budget*	■ *Knowledge of cost benefit analysis tools and procedures* ■ *Ability to understand technical specifications*	■ *Ability to know when to consult others for advice or approval* ■ *Ability to evaluate alternative solutions* ■ *Ability to set decision making parameters*
C6. Implement and refine design	■ *Design is implemented and tested by development team and users for functionality and ease of use* ■ *Improvements are incorporated in design when desirable and feasible*	■ *Ability to detect defaults and define resolutions* ■ *Knowledge of iterative development process*	■ *Ability to implement plan of action* ■ *Ability to resolve technical issues* ■ *Ability to troubleshoot problems* ■ *Ability to evaluate effectiveness of design*
C7. Develop components and integrate into system	■ *Components are developed and tested* ■ *Compatibility problems are resolved, and components are integrated into a fully functional system* ■ *System is tested and refined for functionality*	■ *Knowledge of integration tools and techniques* ■ *Ability to visualize flow and integration strategies* ■ *Understanding of system integration issues*	■ *Ability to evaluate system performance* ■ *Ability to resolve conflicts* ■ *Ability to propose simple technological solutions*

FUNCTION: DESIGN / DEVELOPMENT

TASK	PERFORMANCE CRITERIA *How do we know when the task is performed well?*	TECHNICAL KNOWLEDGE *Skills, Abilities, Tools*	FOUNDATION SKILLS AND PERSONAL QUALITIES
C8. Document design procedure and final design	■ *Overall design procedure, final system design, and test processes and results are documented in a format and level of detail appropriate to specific project*	■ *Knowledge of documentation procedures* ■ *Knowledge of word processing software*	■ *Ability to write technical documentation* ■ *Ability to present complex ideas/information* ■ *Ability to synthesize information* ■ *Ability to organize information* ■ *Ability to create supporting documents* ■ *Ability to write clearly and concisely*
C9. Identify, document and communicate maintenance requirements	■ *Maintenance requirements are identified, and recommendations are communicated to user*	■ *Knowledge of maintenance tools and procedures* ■ *Ability to translate customer's needs into maintenance requirements* ■ *Ability to communicate with audiences with various levels of technical expertise* ■ *Knowledge of word processing software*	■ *Ability to write technical documentation* ■ *Ability to communicate with audience with various levels of technical expertise* ■ *Ability to present complex ideas/information* ■ *Ability to create supporting documents*

FUNCTION: TESTING/VALIDATION

TASK	PERFORMANCE CRITERIA *How do we know when the task is performed well?*	TECHNICAL KNOWLEDGE *Skills, Abilities, Tools*	FOUNDATION SKILLS AND PERSONAL QUALITIES
D1. Develop and conduct test/ validation plan	■ *Timely project testing is an integral part of the design and development process* ■ *Test plan takes into account appropriate resources and is in line with project scope and goals*	■ *Knowledge of testing methodology and test system* ■ *Ability to recognize problems identified by test procedure* ■ *Ability to identify and evaluate inefficient system performance* ■ *Knowledge of application environment and user requirements* ■ *Knowledge of user level of expertise*	■ *Ability to understand system organization/ hierarchy* ■ *Ability to follow processes/ procedures* ■ *Ability to communicate with audiences with various levels of technical expertise* ■ *Ability to understand the complaint/ discrepancy* ■ *Ability to interpret, clarify, and influence communication*
D2. Interpret and document test results	■ *Test results are summarized and documented* ■ *Issues and recommendations are communicated to the design/development team*	■ *Knowledge of documentation procedures* ■ *Knowledge of word processing software* ■ *Ability to identify major issues and make recommendations*	■ *Ability to write technical documents* ■ *Ability to analyze technology output* ■ *Ability to present complex ideas/ information* ■ *Ability to analyze group/ individual response*

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FUNCTION: INSTALLATION / CONFIGURATION

TASK	PERFORMANCE CRITERIA *How do we know when the task is performed well?*	TECHNICAL KNOWLEDGE *Skills, Abilities, Tools*	FOUNDATION SKILLS AND PERSONAL QUALITIES
E1. Develop installation/ configuration plan	■ *Installation/ configuration plan is practical, appropriate, timely and well documented* ■ *Plan is communicated to affected users*	■ *Knowledge of the impact of the installation plan on whole system* ■ *Knowledge of installation/ configuration processes* ■ *Knowledge of installation constraints and user requirements* ■ *Ability to identify user expectations* ■ *Ability to use and read technical documentation* ■ *Knowledge of compatibility issues and resolution procedures*	■ *Ability to generate solutions* ■ *Ability to devise plan of action* ■ *Ability to formulate technological solutions* ■ *Ability to predict outcomes/ results based on experience or prior knowledge* ■ *Ability to apply reasoning skills to identify requirements* ■ *Ability to evaluate documentation* ■ *Ability to plan and coordinate activities* ■ *Ability to visually analyze relationship between parts/ whole, process/ procedure*
E2. Implement installation/ configuration plan	■ *Installation/ configuration is implemented according to plan and schedule* ■ *System is tested and adjusted for optimal performance after installation/ configuration*	■ *Ability to deal with installation obstacles* ■ *Knowledge of installation/ configuration processes* ■ *Ability to use configuration management tools*	■ *Ability to implement plan of action* ■ *Ability to evaluate system configuration/ stability*
E3. Evaluate processes and outcomes	■ *Evaluation involves all relevant people* ■ *Evaluation reflects strengths and weaknesses, and includes appropriate follow up actions* ■ *Evaluation is documented clearly and concisely*	■ *Ability to reflect on performance with others* ■ *Ability to analyze information and identify interdependencies* ■ *Ability to evaluate installation processes and suggest continuous improvement* ■ *General knowledge of hardware, software and network tools* ■ *Knowledge of installation documentation*	■ *Ability to compare multiple viewpoints* ■ *Ability to pose critical questions* ■ *Ability to interpret and synthesize information* ■ *Ability to present complex ideas/ information*

FUNCTION: ADMINISTRATION / MONITORING / OPERATIONS

TASK	PERFORMANCE CRITERIA *How do we know when the task is performed well?*	TECHNICAL KNOWLEDGE *Skills, Abilities, Tools*	FOUNDATION SKILLS AND PERSONAL QUALITIES
F1. Perform diagnostics and identify abnormal system performance	■ *Diagnosis is complete and accurate, and follows a logical process* ■ *Problems are assessed for criticality and reported to relevant personnel in a timely manner*	■ *Knowledge of diagnostic procedures and processes* ■ *Ability to use diagnostic tools* ■ *Knowledge of operating environments, online resources and networks* ■ *Knowledge of system measurement and monitoring techniques* ■ *Knowledge of verification procedures and acceptable tolerances for both equipment and software*	■ *Ability to think logically and sequentially* ■ *Ability to analyze information* ■ *Ability to pose critical questions* ■ *Ability to create detailed supporting documents* ■ *Ability to monitor and correct system performance* ■ *Ability to judge system effectiveness and efficiency* ■ *Ability to analyze system operation* ■ *Ability to diagnose performance deviations*
F2. Perform routine preventative maintenance	■ *Routine preventative maintenance is performed according to schedule and procedure* ■ *Events are logged in, and findings are documented accurately and completely*	■ *Knowledge of preventative maintenance procedures and processes* ■ *Ability to identify and resolve issues* ■ *Knowledge of escalation procedures* ■ *Ability to outline maintenance procedures*	■ *Ability to organize information* ■ *Ability to create detailed supporting documents* ■ *Ability to follow rules/policies/procedures* ■ *Ability to pay attention to details*

FUNCTION: PROJECT MANAGEMENT

TASK	PERFORMANCE CRITERIA *How do we know when the task is performed well?*	TECHNICAL KNOWLEDGE *Skills, Abilities, Tools*	FOUNDATION SKILLS AND PERSONAL QUALITIES
G1. Develop detailed task list, and project flow chart	■ *Tasks are sued appropriately* ■ *Activities contingent on other activities are sequenced appropriately* ■ *Testing and review are represented adequately for the needs of the project* ■ *Time requirements for resource acquisition are realistic* ■ *Contingency plans are included in the time estimates* ■ *Task list is complete and congruent with project goals*	■ *Ability to use appropriate project management planning tools* ■ *Knowledge of work processes* ■ *Ability to visualize project time and resource requirements at the task level* ■ *Knowledge of spreadsheet and project management software* ■ *Ability to create project scenarios* ■ *Ability to visualize tasks sequentially* ■ *Ability to diagram or document interdependencies*	■ *Ability to analyze situation and formulate plan of action* ■ *Ability to predict outcomes/ results based on experience or prior knowledge* ■ *Ability to visually analyze relationship between parts/ whole and integrate processes* ■ *Ability to consider risks and implications* ■ *Ability to demonstrate sensitivity to stakeholders' concerns and interests*
G2. Secure and manage resources	■ *The use of resources is optimized* ■ *Resources are obtained so that tasks and activities occur as planned*	■ *Ability to request resources both in writing and orally* ■ *Knowledge of operating procedures regarding resource availability* ■ *Ability to coordinate the use of resources with other team members/ groups*	■ *Ability to think creatively* ■ *Ability to adapt to changes*
G3. Monitor and report project status	■ *Appropriate information is gathered from the various parts of the project* ■ *Documentation is accurate, timely and in line with the scope of the project, and with the needs of the project team and customer* ■ *The style and format of reports conform to project requirements* ■ *Project outcomes are evaluated against project goals*	■ *Ability to evaluate project status and outcomes non defensively* ■ *Knowledge of potential impact on whole system* ■ *Knowledge of reporting procedures* ■ *Ability to evaluate project progress* ■ *Knowledge of word processing software*	■ *Ability to accept responsibility for own outcomes* ■ *Ability to interpret and clarify communication* ■ *Ability to present information in a clear, concise and objective manner*

FUNCTION: PROJECT MANAGEMENT

TASK	PERFORMANCE CRITERIA *How do we know when the task is performed well?*	TECHNICAL KNOWLEDGE *Skills, Abilities, Tools*	FOUNDATION SKILLS AND PERSONAL QUALITIES
G4. Identify, communicate and address problems	■ *Significant problems are immediately reported* ■ *Solutions to problems are timely and appropriate to the scope and goals of the project*	■ *Ability to use appropriate tracking procedures* ■ *Ability to evaluate project progress* ■ *Knowledge of potential impact on whole system* ■ *Ability and willingness to adjust plans and milestones to changing priorities or customer requirements* ■ *Ability to determine project components to be modified or improved*	■ *Ability to formulate and organize processes* ■ *Ability to identify milestones based on experience or prior knowledge* ■ *Ability to evaluate information for accuracy*
G5. Identify risks and potential problems, and prepare contingency plans	■ *Risk identification is complete and considers impact on whole system* ■ *Alternatives and tradeoffs are identified and explored* ■ *Risks and contingency plan are well documented and communicated to team members*	■ *Ability to project potential risk scenarios* ■ *Ability to non-defensively evaluate risks* ■ *Knowledge of potential impact on whole system* ■ *Ability to create alternatives* ■ *Ability to forecast potential pitfalls*	■ *Ability to predict potential risks based on experience or prior knowledge* ■ *Ability to compare multiple viewpoints* ■ *Ability to pose critical questions* ■ *Ability to identify contingencies based on experience or prior knowledge*
G6. Participate in project reviews and documentation	■ *Appropriate information is presented in the context of the whole project* ■ *Information is presented in a clear and concise form* ■ *Participation in team meetings and reviews is active and productive* ■ *Complete project phase results are documented and clearly communicated*	■ *Ability to participate in a group process* ■ *Ability to evaluate project progress* ■ *Knowledge of potential impact on whole system* ■ *Ability to evaluate project status and outcomes non-defensively* ■ *Knowledge of standard operating procedures regarding project reviews* ■ *Knowledge of word processing software*	■ *Ability to actively participate based on experience or prior knowledge* ■ *Ability to examine information for relevance and accuracy* ■ *Ability to interpret and clarify communication* ■ *Ability to accept responsibility for own outcomes* ■ *Ability to present information in a clear, concise and objective manner* ■ *Ability to communicate with audiences with various levels of technical expertise*

FUNCTION: TASK MANAGEMENT

TASK	PERFORMANCE CRITERIA *How do we know when the task is performed well?*	TECHNICAL KNOWLEDGE *Skills, Abilities, Tools*	FOUNDATION SKILLS AND PERSONAL QUALITIES
H1. Define personal scope of work, and time and activity plan to meet overall project objectives	■ *The purpose, size and the specifics of the tasks are identified accurately* ■ *Tasks are prioritized according to project needs, and parallel tasks are managed effectively* ■ *Criteria for successful completion of the tasks are identified* ■ *Plan is coordinated with project team and plan changes are communicated promptly*	■ *Ability to visualize project time requirements at task level* ■ *Ability to use appropriate time management methods* ■ *Knowledge of applicable standards* ■ *Knowledge of system procedures and constraints* ■ *Knowledge of word processing and spreadsheet software* ■ *Ability to coordinate with others to meet deadlines* ■ *Knowledge of task-related work processes and procedures*	■ *Ability to analyze situation and formulate task sequence* ■ *Ability to predict outcomes/ results based on experience or prior knowledge* ■ *Ability to visually analyze relationship between parts/ whole and integrate processes* ■ *Ability to devise and implement plan of action* ■ *Ability to stay focused on desired outcomes*
H2. Identify and obtain tools and resources to do the job	■ *Necessary supplies and tools are requested in a timely manner, so that they are available when needed* ■ *Budget guidelines for tools and supplies are followed*	■ *Ability to forecast tools and resources* ■ *Ability to access needed tools and resources* ■ *Knowledge of material request procedures* ■ *Ability to analyze cost and benefit of various tools and resources*	■ *Ability to analyze situation and create a list of required tools and resources* ■ *Ability to coordinate acquisition, storage and distribution of software and hardware*
H3. Generate and maintain task status report	■ *Information and documentation is accurate, clear, concise and up to date* ■ *The style and form of documentation conforms to the requirements of the project*	■ *Ability to evaluate task outcomes non-defensively* ■ *Knowledge of documentation requirements* ■ *Knowledge of word processing software*	■ *Ability to make process improvements based on report outcomes* ■ *Ability to evaluate relevance of data needed in report* ■ *Ability to create concise report*

FUNCTION: PROBLEM SOLVING/TROUBLESHOOTING

TASK	PERFORMANCE CRITERIA *How do we know when the task is performed well?*	TECHNICAL KNOWLEDGE *Skills, Abilities, Tools*	FOUNDATION SKILLS AND PERSONAL QUALITIES
I1. Define the problem	■ *Problem definition is documented clearly and concisely* ■ *Problem definition includes relevant facts and data, and overall impact on project*	■ *Knowledge of system norms and operations* ■ *Knowledge of problem isolation tools and procedures* ■ *Ability to document abnormal events in detail*	■ *Ability to understand system discrepancies* ■ *Ability to examine information/data for relevance and accuracy* ■ *Ability to distinguish between problem symptoms and causes* ■ *Ability to clarify and frame problems*
I2. Perform appropriate analysis to identify problem cause	■ *Appropriate analysis techniques are identified* ■ *Analysis is complete and documented* ■ *Cause(s) of the problem and impact are identified and documented*	■ *Ability to create and test a theory* ■ *Ability to perform causal analysis* ■ *Ability to identify the impact of the problem on the whole system* ■ *Ability to break down the problem*	■ *Ability to think creatively while analyzing problem* ■ *Ability to apply appropriate principles/laws/ theories to situation* ■ *Ability to analyze information and identify interdependencies*
I3. Identify and test possible solutions	■ *Appropriate solution(s) are identified and appropriate action is determined* ■ *Solutions reflect concern for cost, schedule, and overall impact* ■ *Solutions are adequately tested for effectiveness*	■ *Ability to develop experiments to test a theory* ■ *Ability to develop and test alternative solutions* ■ *Knowledge of operating procedures regarding testing procedures* ■	■ *Ability to apply reasoning skills to identifying potential solutions* ■ *Ability to research additional sources of information* ■ *Ability to generate/evaluate solutions with others* ■ *Ability to assess the feasibility and relevance of a solution*
I4. Develop resolution plan	■ *Resolution plan is identified, communicated to team and agreed upon*	■ *Ability to facilitate solution selection* ■ *Knowledge of the impact of solutions on whole system*	■ *Ability to gather data, analyze, and reach decisions and agreements* ■ *Ability to resolve technical issues* ■ *Ability to propose options/solutions based on research*

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FUNCTION: PROBLEM SOLVING/TROUBLESHOOTING

TASK	PERFORMANCE CRITERIA *How do we know when the task is performed well?*	TECHNICAL KNOWLEDGE *Skills, Abilities, Tools*	FOUNDATION SKILLS AND PERSONAL QUALITIES
15. Implement and document solution	■ *Resolution plan is implemented in an efficient and timely manner* ■ *Problem, resolution plan and recommendations are documented appropriately*	■ *Ability to assess resolution plan on a continuous basis* ■ *Knowledge of change management procedures* ■ *Ability to deal with implementation obstacles* ■ *Knowledge of word processing software*	■ *Ability to organize new processes/procedures* ■ *Ability to predict outcomes/results based on experience or prior knowledge* ■ *Ability to implement plan of action* ■ *Ability to write and edit technical documents* ■ *Ability to communicate with a variety of audiences*

FUNCTION: FACILITATION/CUSTOMER SERVICE

TASK	PERFORMANCE CRITERIA *How do we know when the task is performed well?*	TECHNICAL KNOWLEDGE *Skills, Abilities, Tools*	FOUNDATION SKILLS AND PERSONAL QUALITIES
J1. Manage working relationships with customers	■ *Relationships are effectively managed and agreed upon expectations are met in a timely manner* ■ *Important information between relevant groups is relayed in a timely manner*	■ *Ability to obtain customer approval* ■ *Knowledge of support boundaries* ■ *Knowledge of operating environments, office suite applications, networks, hardware tools and online resources* ■ *Knowledge of ultimate goal*	■ *Ability to accept responsibility for own behavior and impact on others* ■ *Ability to demonstrate commitment to personal/social improvement* ■ *Ability to be flexible and cooperative* ■ *Ability to resolve conflict to customer's satisfaction* ■ *Ability to detect underlying issues* ■ *Ability to compare multiple viewpoints* ■ *Ability to encourage cooperation/negotiation*
J2. Manage multiple customer requirements and negotiate service	■ *Customer requirements are prioritized* ■ *Acceptable options are presented and negotiated*	■ *Knowledge of available resources* ■ *Knowledge of negotiation variables* ■ *Ability to identify customer expectations* ■ *Ability to define and communicate workload limits* ■ *Knowledge of department guidelines* ■ *Ability to effectively use available resources* ■ *Ability to understand the importance to communicate with others*	■ *Ability to detect underlying issues* ■ *Ability to apply creative thinking to new situations* ■ *Ability to distinguish between facts and inferences* ■ *Ability to resolve conflict to customer's satisfaction* ■ *Prioritizes daily tasks and prepares schedule* ■ *Ability to monitor/adjust task sequence* ■ *Ability to set and adjust well defined/realistic goals* ■ *Ability to resolve conflict to customer's satisfaction* ■ *Ability to communicate appropriate verbal/nonverbal messages*

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FUNCTION: EDUCATION/TRAINING

TASK	PERFORMANCE CRITERIA *How do we know when the task is performed well?*	TECHNICAL KNOWLEDGE *Skills, Abilities, Tools*	FOUNDATION SKILLS AND PERSONAL QUALITIES
K1. Identify requirements for information or training	■ *Need for additional information and training is evaluated on a continuous basis*	■ *Ability to identify key sources of information* ■ *Knowledge of information gathering methods* ■ *Ability to decide when enough information has been gathered* ■ *Knowledge of word processing and basic operating environments*	■ *Ability to compile multiple viewpoints* ■ *Ability to encourage cooperation* ■ *Ability to ask open ended and confirming questions* ■ *Ability to analyze and summarize group/individual responses*
K2. Identify training content and processes	■ *Training content contains appropriate amount of information and is consistent with the needs of the team and project* ■ *Training format is appropriate for the content, the audience, and the scope of the project*	■ *Knowledge of required technical information* ■ *Ability to identify "need to know"* ■ *Ability to write learning objectives* ■ *Knowledge of word processing and presentation software*	■ *Ability to analyze information* ■ *Ability to identify and prioritize the need for data* ■ *Ability to recognize when information is incomplete or irrelevant*
K3. Organize and present information and training	■ *Training clearly communicates information* ■ *Training is timely and takes appropriate amount of time*	■ *Ability to create appropriate presentation visuals* ■ *Ability to organize technical material for ease of learning* ■ *Knowledge of word processing and presentation software*	■ *Ability to speak clearly and concisely* ■ *Ability to adapt to a variety of audiences*
K4. Evaluate effectiveness of training	■ *Evaluation includes observed strengths and weaknesses of training format* ■ *Evaluation and recommendations are communicated for continuous improvement*	■ *Knowledge of evaluation practices and procedures* ■ *Knowledge of feedback practices*	■ *Ability to analyze data and evaluate accuracy and relevance* ■ *Ability to interpret information non-defensively* ■ *Ability to document "lessons learned" succinctly and accurately*

FUNCTION: DOCUMENTATION/COMMUNICATION

TASK	PERFORMANCE CRITERIA *How do we know when the task is performed well?*	TECHNICAL KNOWLEDGE *Skills, Abilities, Tools*	FOUNDATION SKILLS AND PERSONAL QUALITIES
L1. Document various phases of project, and communicate with customers and team members	■ *The format, level of detail and timeliness of documentation/ communication meets the needs of the project* ■ *Documentation/ communication is developed at all appropriate phases of the project and is targeted to appropriate audience*	■ *Knowledge of the principles of technical writing and presentation* ■ *Knowledge of technical writing tools, methods and delivery options* ■ *Ability to translate technical terminology and concepts*	■ *Ability to interpret and summarize research information* ■ *Ability to analyze and synthesize information* ■ *Ability to write clearly and concisely* ■ *Ability to use appropriate language, style organization and format*

APPENDIX 3: RESOURCE LIST

Competency-based Education

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SCANS 2000: *www.scans.jhu.edu/*

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